

Chapter 3

HISTORY OF THE MEDICAL MANAGEMENT OF CHEMICAL CASUALTIES

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INTRODUCTION

Much that is known today about the medical management of chemical casualties resulted from experience with the large number of chemical casualties managed during World War I. However, because chemicals have scarcely been used on the battlefield since then, the US armed forces have yet to apply the chemical lessons learned from that war on a large scale. This chapter continues the series of history chapters in this textbook begun in Chapter 2, *History of Chemical Warfare*, which provides a detailed history of chemical weapons in World War I and subsequent incidents of their use on the battlefield, which gave rise to the casualties discussed here. Chapter 4, *History of the Chemical Threat, Chemical Terrorism, and Its Implications for Military Medicine*, will provide further insight into the subject.

Integrating the specifics of chemical casualty support within general medical and surgical support involves numerous command and staff actions. These actions interface at all command echelons and with all components of a commander's staff. For example, the ability to train the appropriate number of personnel involves personnel actions, and knowing what medi-

cal materiel needs to be emplaced requires gathering medical intelligence. World War I provided insight into how to manage all aspects of medical support in the event of a chemical attack. Specialty care personnel, physicians, nurses, and first responders required training, and how these trainees performed in the theater of combat required operations and planning action.

The medical logistics portion of a unit supplies trained troops with the specific tools and equipment to perform their specialty missions. None of these staff actions can exist without the establishment, direction, and supervision of leadership elements throughout every echelon of military organization. However, the initial management of chemical casualties did not always have the defined leadership and staff actions it does currently; the management process has been refined as the nature of chemical warfare and its resulting casualties have evolved over time. Because military physicians base treatment regimens on both the quality and quantity of the anticipated combat injuries, the main focus of this chapter is World War I, when organized paradigms were first developed to handle a potentially massive influx of chemical casualties.

HISTORY UNTIL WORLD WAR I

Although historians do not agree on what devices should be considered the first chemical weapons, the signs and symptoms of weapon-induced pathology were documented long before World War I. From the earliest times, physicians managed natural "chemical" casualties. Animal and plant agents, such as jellyfish; man-o-wars; spitting snakes; skunks; poison ivy, sumac, and oak; and stinging nettles provided physicians with a variety of casualties and clinical presentations.^{1,2} Around the recorded times of early Troy (1200 BCE), weapons such as arrows were wrapped with flammable plant fibers (flax, hemp, or straw) and set afire, and military physicians used appropriate medications and therapies to treat the resulting injuries.³ The Chinese used arsenic and sulfur tactically during 1000 to 700 BCE to produce irritating fogs, fumes, and poisonous smoke balls that affected soldiers' airways. One specific concoction that called for aconite root, wolfsbane, and croton bean engendered blisters and pustules in airways and on skin surfaces.³ As a result, casualty types broadened from pulmonary and respiratory to dermatological (vesicant).

Around 600 BCE Solon documented that hellebore roots thrown into a river gave rise to profuse diarrhea, forcing military physicians to manage the resulting severe dehydration without intravenous fluid resuscitation.³ In *History of the Peloponnesian War*, Thucydides

described chemical warfare and the types of casualties it produced during the 5th-century BCE conflict between Athens and Sparta. Thucydides tells how Sparta's allies, the Boethians, took an Athenian fort at Delium in 424 BCE with an engine filled with lighted coals, sulfur, and pitch, which made a great blaze and set fire to the fort walls. The defenders abandoned the fort, leaving pulmonary casualties in need of medical treatment.⁴ Later, Romans used mucous-membrane irritants against the Ambracians, allies of Corinth, during 193 to 189 BCE. The medical management of these casualties undoubtedly involved removing them from irritant sources and flushing irritated surfaces with copious amounts of water. In the 9th century CE, Leo IX of Byzantium, writing on warfare, described hand-thrown "vases filled with quicklime," the effects of which had been known since the Peloponnesian War. Quicklime was one of three combustible substances known in the Mediterranean at that time (the other two were sulfur and pitch). When broken, the vases of quicklime let loose an overpowering odor that suffocated anyone nearby.⁵

From that point onward, various types of chemical weaponry were engaged. Over time, military physicians developed the most effective leadership, staff organization, and curative techniques to maintain the effectiveness of the fighting force during and following

a chemical attack. As 1914 drew near, chemicals used on the battlefields were primarily irritants. In the early years of World War I, the Germans employed nontoxic “ni-shells” and “T-shells,” containing xylyl bromide (see Chapter 2).⁶ Because these chemicals were nontoxic and

their employment as weapons was tactically unsound, the combatant armies established no real medical support organization or protocol to respond—organized management of chemical casualties was not necessary because no elevated influx of chemical patients occurred.

WORLD WAR I

World War I heralded several battlefield discoveries that changed the face of warfare and the future chemical threat. In addition to causing large numbers of casualties, gas was an effective and versatile weapon because it placed an additional strain on every aspect of combat. According to British Major General Charles H Foulkes, the “appearance of gas on the battlefield . . . changed the whole character of warfare.”^{7(p345)} Gas permeated clothing, food, and water. It corroded human skin, internal organs, and even steel weapons. Its smell lingered in the air. Not only did soldiers have to train constantly in emerging chemical warfare, but an entire logistical network had to be established for offensive and defensive gas equipment. As a result, a new branch of the US Army came into existence, and



Fig. 3-1. The mobile decontamination facility was an essential part of the degassing station, and plans called for two per division. As events transpired, only one experimental mobile decontamination facility was actually constructed, and it was never used in combat. Its objective was “to give hot baths and clean clothing to those subjected to the fumes of mustard gas at the nearest possible points to where gas bombardments take place.”¹ Given what is now known about the speed with which mustard injury develops, attempting to slow the progression of mustard injury by this regimen was most likely ineffective. Nevertheless, by providing a shower and clean clothing, the degassing station would have played an important role in improving the general sanitation and morale of combat troops.

(1) Gilchrist HL. Field arrangements for gas defense and the care of gas casualties. In: Weed FM, ed. *Medical Aspects of Gas Warfare*. Vol 14. In: Ireland MW, ed. *The Medical Department of the United States Army in the World War*. Washington, DC: Government Printing Office; 1926: Chap 4: 61.

Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

new units, such as decontamination squads, mobile degassing units, and special gas troops, were created (Figure 3-1). Combat arms officers became gas officers in divisions, regiments, and battalions, reducing the number of combat arms personnel. The impact of gas on the Medical Department also posed tremendous problems for casualty treatment. The number of gas wounded became so great that one field hospital out of four per division was dedicated solely to the treatment of gas casualties (Table 3-1).⁷

Prewar Intelligence and the Second Battle of Ypres

The failure to plan for chemical warfare in World War I was a strategic error on the part of the Allies because they had sufficient intelligence to warrant preparation. In the time leading up to the first gas attack at Ypres, intelligence of chemical weaponry mounted. Trepidation existed on both sides of the trenches, however. According to the official German World War I military history, *Der Weltkrieg*, constant reports by the foreign press appeared in the early weeks of the war about new inventions and secret weapons that might

TABLE 3-1

CHEMICAL CASUALTIES IN WORLD WAR I

Country	Nonfatal Chemical Casualties	Chemical Fatalities	Percentage Fatal
Germany	191,000	9,000	4.5
France	182,000	8,000	4.2
British Empire	180,597	8,109	4.3
United States	71,345	1,462	2.0
Russia*	419,340	56,000	11.8

*The data from which these figures were derived have apparently been lost to history. However, the Russians themselves analyzed their casualty statistics from World War I. The Narkomzdrav Commission found the figures for nonfatal and fatal gas casualties to be only about one tenth as great as AM Prentiss’s values, which are the ones commonly accepted in the West (total gassed casualties: 40,000–65,000; total gas fatalities: 6,340).

Data sources: (1) Prentiss AM. *Chemicals in War: A Treatise on Chemical Warfare*. New York, NY: McGraw-Hill; 1937: 653. (2) Kohn S. *The Cost of the War to Russia*. New York, NY: Howard Fertig; 1973: 136.

be used against the German army. A French chemist, Eugene Turpin, reportedly created a secret weapon that caused injury without a visible external wound.⁸

Germany's first chemical weapon was chlorine gas. In the winter of 1914–1915, German chemist and professor Fritz Haber came up with the idea of generating a chlorine gas cloud to attack the enemy line, an improvement on Walther Nernst's recommended chlorine gas artillery munitions. By blowing the chlorine from a point source, such as fixed cylinders in a front line trench, it was thought possible to create a chlorine cloud that would creep across the ground and down into the trenches in enough measure to create mass casualties (Figure 3-2). Chlorine gas was intended to render troops incapable of fighting but was not considered to have a lasting physical effect.⁹

Despite the warnings of potential chemical attack, neither the French, Algerians, British, nor Canadians prepared personal protective measures or plans for managing chemical casualties. On April 13 a German deserter, Private August Jaeger, told French authorities:

An attack is planned for the near future against the French trenches of the above mentioned sector. With this object in view four batteries have been placed in position in the first line trenches; these batteries each have 20 bottles of asphyxiating gas. Each Company has 4 such batteries. Each battery has 5 gunners. At a given signal—3 red rockets fired by the artillery—

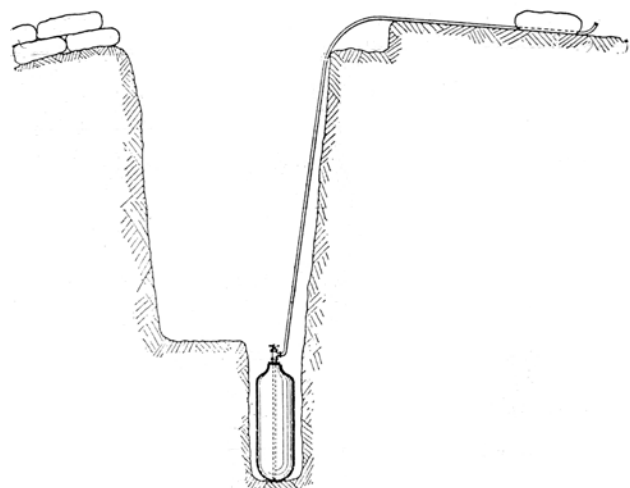


Fig. 3-2. A typical German chemical cylinder set up and ready for discharge. The discharge from thousands of cylinders created a gas cloud.

Reproduced from: Army War College. German methods of offense. Vol 1. In: *Gas Warfare*. Washington, DC: War Department; 1918: 14.

the bottles are uncorked, and the gas on escaping, is carried by a favourable wind towards the French trenches. This gas is intended to asphyxiate the men who occupy the trenches and to allow the Germans to occupy them without losses. In order to prevent the men being themselves intoxicated by the gas, each man is provided with a packet of tow steeped in oxygen.^{10(pp228-229)}

Two days later, another German deserter, Julius Rapsahl, claimed that a cotton mouth protector was issued to German soldiers for protection in the event that the Allies attacked them with gas.¹⁰ Additionally, a reliable Belgian intelligence agent warned that German "reserves have been brought up and passages have been prepared across old trenches existing in rear of present German trenches to facilitate bringing forward artillery. Germans intended on making use of tubes with asphyxiating gas placed in Bts. [batteries] of 20 tubes for every 40 metres in front of 26th Corps."^{10(p231)} The appendix in the *British Second Army War Diary* noted "it is possible that if the wind is not favourable to blow the gases over our trenches that the attack may be postponed."^{10(p231)} An additional information bulletin was received by French general headquarters from the Belgian army's deputy chief of staff. According to the bulletin, a Belgian agent had sent word that the Germans had placed an urgent order at a factory in Ghent for the provision of 20,000 mouth protectors made of tulle that soldiers could carry in waterproof packets.¹¹

This information was subsequently published in the French army's *Bulletin de Renseignements de la Détachement d'Armée de Belgique*. Copies were sent to the British general headquarters, and translations were circulated to the general staff, but the intelligence was essentially ignored by Allied headquarters.¹² Because chemical warfare was an unknown entity, the likelihood of the event was greatly minimized.

On the evening of April 22, 1915, during the Second Battle of Ypres, chlorine gas, released from point sources, created a large number of bewildered chemical casualties (Figure 3-3). A German soldier, part of a specialized chemical engineer unit in Ypres, Belgium, reported:

That day was a Thursday in April 1915. Finally we decided to release the gas. The weatherman was right. It was a beautiful day, the sun was shining. Where there was grass, it was blazing green. We should have been going to a picnic, not doing what we were about to do. The artillery put up a really heavy attack, starting in the afternoon. The French had to be kept in their trenches. After the artillery was finished, we sent the infantry back and opened the valves with strings. About supper time, the gas started toward

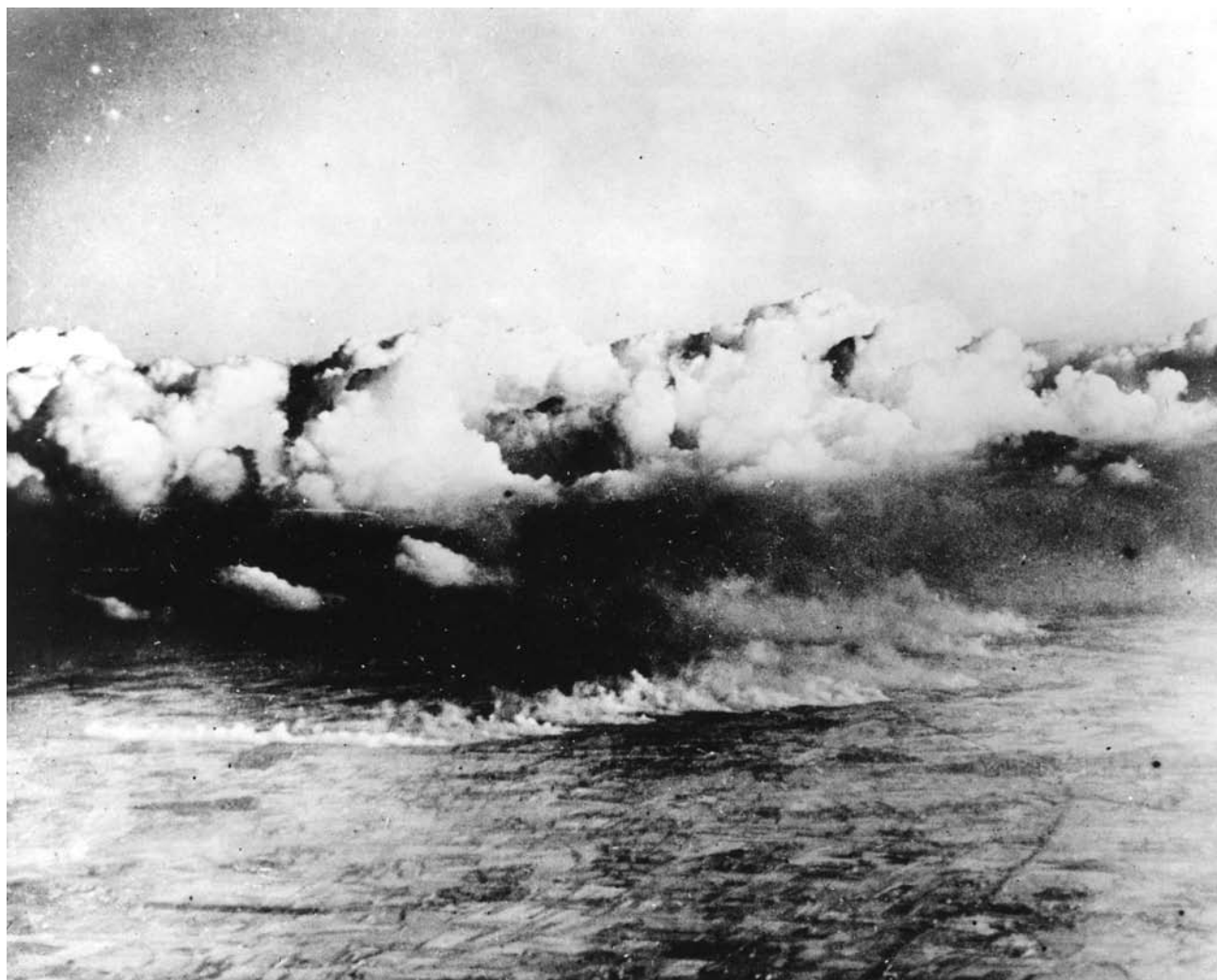


Fig. 3-3. This photograph is reputed to show the German chlorine gas cloud attack at Ypres, Belgium, on April 22, 1915. Although there is little evidence to support this claim, the photograph does show a visible cloud, probably created by a cylinder attack.

Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

the French, everything was quiet. We all wondered what was going to happen.

As this great cloud of green gray gas was forming in front of us, we suddenly heard the French yelling. In less than a minute, they started with the most rifle and machine gun fire that I had ever heard. Every field artillery gun, every machine gun, every rifle that the French had must have been firing. I had never heard such a noise. The hail of bullets going over our heads was unbelievable, but it was not stopping the gas. The wind kept moving the gas towards the French lines. We heard the cows bawling, and the horses screaming. The French kept on shooting. They couldn't possibly have seen what they were shooting at. In about fifteen minutes, the gun fire started

to quit. After a half hour, only occasional shots [were heard]. Then everything was quiet again.

In a while it had cleared and we walked past the empty gas bottles [cylinders]. What we saw was total death. Nothing was alive. All of the animals had come out of their holes to die. Dead rabbits, moles, rats, and mice were everywhere. The smell of the gas was still in the air. It hung on the few bushes that were left. When we got to the French lines, the trenches were empty. But in a half mile, the bodies of French soldiers were everywhere. It was unbelievable. Then we saw that there was some English. You could see where men had clawed at their faces, and throats, trying to get their breath. Some had shot themselves. The horses, still in the stables, cows, chickens, everything, all

were dead. Everything, even the insects were dead.

We started counting the casualties. This operation was so much bigger than we had ever imagined. That night we guessed over 20,000 French soldiers, and even more town people had died. The infantry followed us but when they couldn't find any French to fight, they stopped. All of us went back to our camps and quarters wondering what we had done. What was next? We knew what happened that day had to change things.¹³

The number of French and Algerian soldiers killed that day is estimated to be about 10,000. The number of civilians and animals killed is undetermined. Even as the chemical casualties from the attack began filtering into rear areas, the response was generally denial. When the word of a chemical attack reached Harvey Cushing, an American physician working with the French at Compiègne, he responded with disbelief (Exhibit 3-1):

It was soon whispered about that this lot had come from Ypres and that they had all suffered greatly from some German gaz asphyxiant [*sic*]; but I hardly believed the tale, or thought I had misunderstood, until this evening's communiqué bears it out. Many of them were coughing; but then, as I've said, most of the wounded still come in with a bronchitis. We have heard rumors for some days of a movement of German troops in the direction of Ypres, and this attack is apparently the result.

EXHIBIT 3-1

DR HARVEY CUSHING

Dr Harvey Cushing experienced the western front in the French and British sectors of occupation before the American Expeditionary Forces deployed medical support. His first duty was in the early spring of 1915, when he served with a Harvard unit in the American Ambulance at Neuilly, France. At that time he became familiar with the French Service de Santé. From Paris he visited the British Royal Army Medical Corps in Flanders. He managed chemical casualties during the battles for the Messines and Passchendaele ridges in Flanders at the time of the Third Battle for Ypres. His observations as an American physician gave insight into how American wartime medical management of chemical casualties compared to international standards.

Data source: Cushing H. *From a Surgeon's Journal, 1915–1918*. Boston, Mass: Little, Brown and Company; 1936.

When we got back to the Ambulance, the air was full of tales of the asphyxiating gas which the Germans had turned loose on Thursday—but it is difficult to get a straight story. A huge, low-lying greenish cloud of smoke with a yellowish top began to roll down from the German trenches, fanned by a steady easterly wind. At the same time there was a terrifically heavy bombardment. The smoke was suffocating and smelled to some like ether and sulphur, to another like a thousand sulphur matches, to still another like burning rosin. One man said that there were about a thousand Zouaves of the Bataillon d'Afrique in the lines and only sixty got back either suffocated or shot as they clambered out of the trenches to escape. Another of the men was en repos five kilometres [*sic*] away and says he could smell the gas there. He with his fellows was among those of the reserves who were called on to support the line, but by the time they got up the Germans were across the canal, having effectively followed up their smudge. They seem to have been driven out later, or at least the seamen thought they had been. We'll have to await the official communiqués, and perhaps not know even then. In any event, there's devil's work going on around Ypres, and the heralded "spring drive" seems to have been initiated by the Germans. . . .

Then we saw many of the severely "gassed" men who had come in this morning—a terrible business—one man, blue as a sailor's serge, simply pouring out with every cough a thick albuminous secretion, and too busy fighting for air to bother much about anything else—a most horrible form of death for a strong man.^{14(p69)}

Initial Responses

The deliberate use of tactical chemicals on an unprepared enemy created a marked change in the nature of the casualty. It was quickly learned that chemical agents had a debilitating effect on soldiers: not only did the chemicals physically injure soldiers, but they also added a psychological element that common artillery could not match. During a chemical attack, soldiers felt that other than masking, they had no real defense. This resulted in a "gas-fright" syndrome hallmarked by psychological depression and war weariness. Untrained physicians were unsympathetic to those suffering from "gas poisoning" and the battle fatigue it caused, often accusing soldiers of malingering. Unfortunately, few physicians knew how to medically manage a chemical casualty at the onset of the war (Table 3-2). In the absence of a remedy, soldiers were given bed rest with the hope that the body's intrinsic healing abilities would be adequately facilitated.

On a chemical battlefield, normal medical opera-

TABLE 3-2

**SIX CHLORINE-PHOSGENE CLOUD ATTACKS:
BRITISH CASUALTIES DECEMBER 1915–
AUGUST 1916**

Casualties	Percentage
Gas casualties as a percentage of exposed troops	4.1
Deaths from gas as a percentage of troops	0.7
Deaths from gas as a percentage of total gas casualties	23.6

Adapted with permission from: Moore W. *Gas Attack*. London, England: Leo Cooper; 1987: Appendix D.

tions were encumbered by protective gear; soldiers who did not follow the strict protective measures soon became casualties. Ultimately, half the battle casualties during the war were attributed to gas. One officer wrote of the attacks:

When sent out into the darkness to bring in the wounded or perform other duties . . . the [soldiers] repeatedly removed the face part of the S.B.R. [small box respirator] so as to see what they were doing or where they were going. . . . Others, straining at the heavy loads of bringing in casualties found the mask painfully oppressive and removed it. [Only] one who has been under such a night bombardment can realize the difficulties attending the supervision and control of gas discipline during such a time.^{15(p13)}

The early poor gas discipline was blamed on the ineffectiveness of the British small box respirator and French M2 masks, which were issued to all American Expeditionary Forces (AEF) personnel entering the theater (Figure 3-4). The adoption of a better mask was recommended early in response to the AEF's Chemical Warfare Service (CWS) and 1st Division Medical Corps complaints.¹⁵ One soldier said of the equipment: ". . . surgeons, stretcher bearers, and runners, had found it impossible to carry on in the SBR because the arrangement of the eyepieces and the fogging of the lenses impaired vision."^{15(pp19–20)}

Pulmonary agents were used first on the battlefield, and the resulting casualties were managed under the medical doctrine of the French and British medical systems. Later, the Germans developed sulfur mustard, a vesicant (blister agent) that attacked the skin, making masks less effective (Figure 3-5). Mustard was first used on July 12, 1917, just prior to the Third Battle of Ypres, and the Allies had to devise a medical response to this new type of agent.¹⁶



Fig. 3-4. The British small box respirator, introduced in 1916 and seen in 1918 in this photograph, was vastly more effective than the earlier British versions. The wearer breathed through a mouthpiece. Because a spring clip was applied to the nose, only air that had passed through the mouthpiece could enter the lungs. An absolute seal between the face and mask was unnecessary. The mouthpiece was connected by a tube to the canister containing neutralizing chemicals, which was worn around the trunk. Although the small box respirator was more protective than its predecessors, it was probably less user-friendly.

Reproduced from: Pictorial History, Gas Defense Division, Chemical Warfare Service. Vol 5. Edgewood Historical Files. Located at: Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

As World War I progressed, physicians became more adept at managing chemical casualties, though bed rest remained the most common form of treatment. Soldiers who inhaled large volumes of asphyxiating gases usually died. Mustard was probably the most difficult agent to medically manage because it temporarily blinded individuals, produced blisters on the skin, and resulted in a large number of casualties who required extensive medical treatment. As the number of chemical casualties increased, field hospitals became overburdened. Eventually, some special hospitals were erected to deal solely with soldiers suffering from chemical-related injuries. The number of chemical casualties produced was staggering, and the forward-deployed Canadian, French, and Algerian dressing stations were quickly overwhelmed.

Another setback early in the war was the abysmal field sanitation French and British troops had to deal



Fig. 3-5. Allied response to the use of gas was to create myriad devices designed to protect the respiratory system. By 1917 the Germans had found a way to defeat the effectiveness of these masks by introducing vesicants, agents that attacked the skin as well. Top row, left to right: US Navy Mark I mask; US Navy Mark II mask; US CE mask; US RKF mask; US AT mask; U.S. KT mask; US model 1919 mask. Middle row, left to right: British Black Veil mask; British PH helmet; British BR mask; French M2 mask; French artillery mask; French ARS mask. Bottom row, left to right: German mask; Russian mask; Italian mask; British Motor Corps mask; US Rear Area mask; US Connell mask. Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

with. The French trenches taken over by Canadian and American forces were found in poor condition. Personal accounts from Canadian soldiers document the overpowering stench from numerous dead French and German soldiers buried in shallow graves in or near the trenches or left unburied. Captain TC Irving, commanding officer of the Second Field Company, Canadian Divisional Engineers, reported that "... things were in a deplorable state from the standpoint of defence, safety and sanitation, and large quantities of disinfectant should be sent into the trenches immediately for liberal use."¹⁰ His report continues:

The right flank and the next portion to the left had a parapet of mud heaped up in front approximately 2 feet thick at the bottom and from 4 inches to 1 foot at

the top with an occasional loophole punched through the earth. . . . The water level is about two feet down below the surface of the ground with numerous shell holes and also a section of the trench behind partially filled with water. There was a plugged drain passing between these two sections in a North Easterly direction through the German lines. In front of these sections are numerous bodies buried at a very shallow depth making it impossible for us at many places to excavate at all. There is also human excreta littered all over the place.

Going to the left we next strike 650 feet of firing line completely enfiladed by the enemy's artillery, which had no traverses in it. The parapet ranged from 2 feet to 4 feet in height and from 6 inches at the top to three feet at the bottom in thickness. The ground where the men stand in the firing position is paved with rotting

bodies and human excreta. The ground behind is full of excreta and dead bodies.^{10(pp235-238)}

The French army's structure was responsible for the unsanitary state seen by the arriving Canadians. The French medical service was part of the only World War I combatant army whose medical officers (MOs) were not organized in a separate corps. The absence of an independent medical service meant that medical issues were under the auspices of the French combat arms leadership and maneuver commanders. Field sanitation and troop hygiene were lower priority than tactical matters. Almost all water supplies were infected by *Salmonella typhi*. The French army experienced 50,000 cases of typhoid in the first 3 years of the war.^{17,18} Because the French medical service was plagued with problems, the Americans arriving on the western front looked to the British Royal Army Medical Corps as a template for medical organization. During the early part of World War I, the US Army surgeon general assigned a number of MOs to act as observers within the French and British armies. Reports on the medical aspects of the European conflict, including the diagnosis and treatment of chemical casualties, were received by the surgeon general from 1916 onward.

Royal Army Medical Corps

The Royal Army Medical Corps had three main responsibilities during the war: (1) sanitation (physical and environmental hygiene), (2) patient transport (evacuation of the sick and wounded), and (3) hos-

pitalization (the medical management of the sick or wounded). Chemical warfare impacted all three (Figure 3-6). Chemical casualties had to be managed in a battlefield creviced with trenches of varying depths. Some had flimsy dugouts that protected troops from the elements but not from artillery shelling. In most places the trenches did not run in a continuous line, but were instead made up of groups of shallow fire and support trenches.¹⁰

Collecting, Evacuating, and Distribution Zones

The Royal Army Medical Corps provided support for itself and for its attached forces. Its management scheme divided the battlefield into the collecting zone, the evacuating zone, and the distribution zone. The collecting zone was the first or forward area to which the wounded were evacuated from the battlefield (Figure 3-7). The middle area, known as the evacuating zone, encompassed the roads, railway lines, and canals along which casualties were transported to the distribution zone. The evacuating zone occasionally contained a medical supply unit or "stationary" hospital for receiving casualties who could not be advanced to the distribution zone (see Figure 3-7). The distribution zone contained the various facilities needed for definitive medical treatment, staffed by logistical and service support units dispersed in a rear area of operations of indeterminate size, including mainland Great Britain. Stationary hospitals out of theater in Great Britain were called "home hospitals," and those outside of Great Britain were called "overseas" or "base hospitals."¹⁹

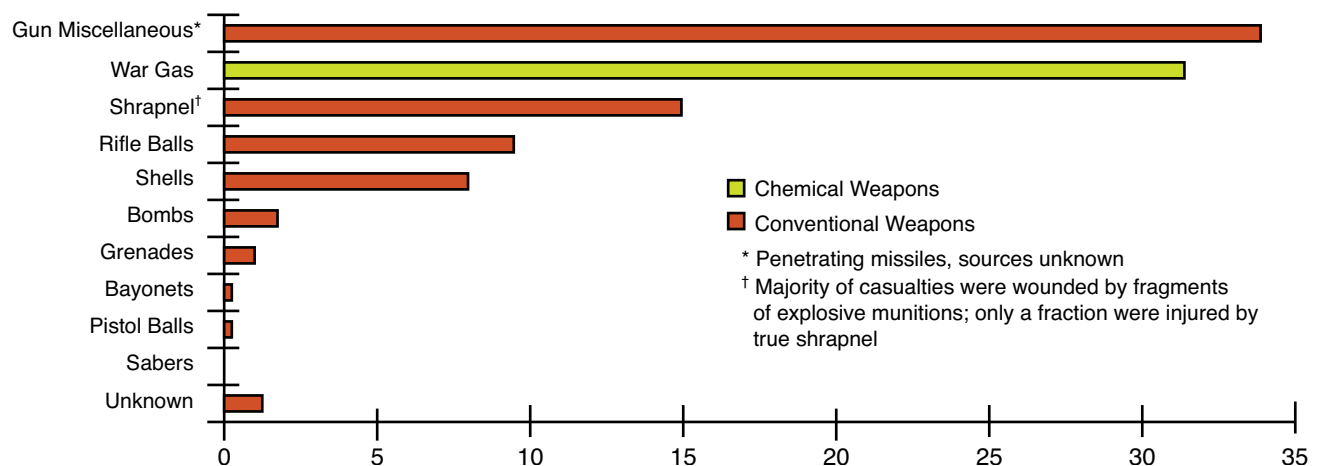


Fig. 3-6. Hospitalized casualties in World War I, in percentages by causative weapon (224,089 casualties). Adapted from: Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Chart 7. Edgewood Arsenal, Md: Chemical Warfare School; 1928:19.

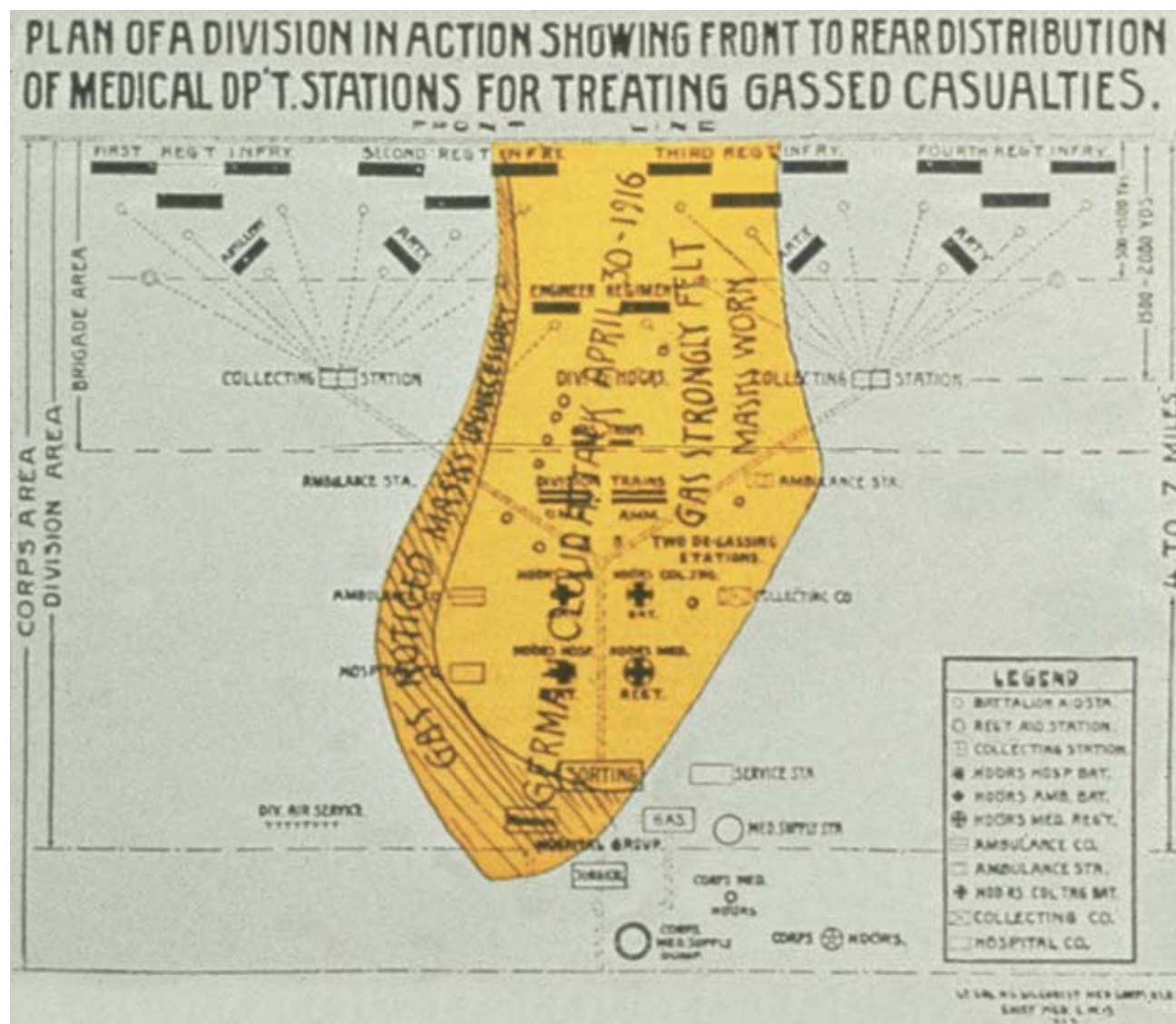


Fig. 3-7. Plan of a division in action. Colonel HL Gilchrist, medical director of the American Expeditionary Force for gas warfare, prepared this illustration for chemical warfare training purposes. The drawing is based on an actual German gas cloud in 1916 but an American division is substituted for the British division that was actually attacked. The gas cloud is seen as totally interrupting the division's medical evacuation system, as well as making its two "degassing stations" inoperative. Reproduced from: Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Edgewood Arsenal, Md: Chemical Warfare School; 1928.

Regimental Aid Posts

The battalion or regimental MO was responsible for the basic design of a regimental aid post equipped for medical and surgical casualty stabilization, which often had to be rapidly established during movement. Depending on the unit's location, the aid post might have been the cellar of a ruined cottage or house, a deserted German dugout, or a shellproof annex to a communication trench. The post needed to offer protection from direct fire and, if possible, be located

adjacent to a road to support evacuation. Regardless of location, the aid post had to protect casualties from further chemical compromise, which was accomplished by closing all doorway openings with blankets soaked in an antigas solution.^{20,21}

The mission of the aid post was to treat for shock (by administering morphine and providing hot drinks) and protect casualties from environmental exposure. Treatment was provided in these forward areas until the casualty flow slackened. Casualties who required stabilization beyond the regimental MO's level of

expertise were evacuated to the next echelon of care: the advanced dressing station. Litter-bearers who originally brought in the casualties transported them from aid posts to advanced dressing stations, or casualties were moved between the two echelons by motorized or horse-drawn ambulances.¹⁹

Advanced Dressing Stations

Advanced dressing stations were set up at locations accessible by the regimental aid posts. Because their locations were further rearward (albeit still in artillery range), an advanced dressing station may have been in a crypt or cellar of a building, such as a church or school. The floor plan of the advanced dressing station was like an enlarged version of a regimental aid post. Provisions were made for casualties that required increased stabilization. Because they were in artillery range, additional care had to be taken to protect staff and patients from chemical attacks. At the advanced dressing station, casualties were further stabilized for continued transport, which was the responsibility of supporting echelons from the field ambulance headquarters or main dressing station. In the presence of a high influx of casualties, the walking wounded were intercepted prior to their arrival at the advanced aid station and sequestered in a holding area called a "divisional collecting post." This collecting post was supported by a field ambulance station. From there, casualties moved to a main dressing station, if needed.¹⁹

Main Dressing Stations

The field ambulance headquarters formed the main dressing station, located outside of artillery range (thus defense against chemical artillery was not a major concern). Field ambulances were responsible for transporting the sick and wounded from the advanced dressing stations to the main dressing stations. Casualties might require an extended stay for treatment at the main dressing station before further evacuation to the clearing stations. Evacuation at this level was carried out by specially equipped motor ambulance convoys. Each motor ambulance car could carry six or eight sitting or four reclining casualties. Unfortunately, chemical casualties in these ambulances were exposed to heated carbon monoxide from the vehicle's exhaust fumes.¹⁹

Casualty Clearing Stations

Casualty clearing stations or railhead hospitals served as the final collecting zones. The casualty clearing station's primary function was to receive

and evacuate casualties to the distribution zone and the stationary base hospitals. Casualty clearing station sites needed adequate ingress for casualties and adequate egress for evacuation by rail, water, or road, and had to provide sufficient interim casualty medical support. The casualty clearing station was obligated to act as a hospital only part of the time, depending on the tactical situation. In some instances, the casualty support mission became so predominant that the term "clearing hospital" evolved. Although some clearing stations were only about 6 miles from the front, many were fully functional as fixed hospitals with trained female nurses (Figure 3-8), ordinary hospital beds, operating tables equipped with electric light, and the same appliances and features found in the hospitals of large towns, such as radiograph equipment and clinical laboratories. Dr Cushing visited one such hospital in Bailleul, Belgium, and recorded Royal Army Medical Corps casualty processing at a clearing station 2 weeks after the first chemical attack (Exhibits 3-2 and 3-3).¹⁴

Base Hospitals

Casualties were evacuated to the base hospital by rail (ambulance train), road (motor convoy), or water (hospital barge). A typical hospital train could carry about 400 casualties. Evacuation by hospital barge was extremely slow and restricted by the availability of navigable canals. Barges traveled only by daylight, at the rate of about 3 miles per hour, taking an average 24 to 48 hours to complete an evacuation. The motor convoy, preferred when speed was essential, was the primary means of evacuation.¹⁹

The medical facilities to which casualties were sent within the distribution zone were also known as "gen-



Fig. 3-8. A nurse irrigates the eyes of soldier who has a probable mustard injury. It is now known that eye irrigation would have provided only symptomatic relief because of the rapidity with which mustard damages tissue. Reproduced from: Moore WE, Crussell J. *US Official Pictures of the World War*. Washington, DC: Pictorial Bureau; 1920.

EXHIBIT 3-2

DR HARVEY CUSHING'S ACCOUNT OF ROYAL ARMY MEDICAL CORPS CAPABILITIES, FLANDERS, BELGIUM, MAY 5, 1917

In normal times Bailleul—a typical old Flemish town—is a peaceful lace-making place of some 13,000 inhabitants with two old picturesque churches. But today, it is a bedlam, packed with motor cars of all kinds, though ambulances predominate, since, owing to the recent evacuation of the clearing station at Poperinghe, the burden has fallen heavily on this place. We visit only one of the several hospitals—an old monastery [monastery], where a long line of ambulances at the moment were being unloaded. Many of the field ambulances and stations have recently been targets for German shells, and there has been a very heavy “take-in,” as they say, for several days. . . .

Through this single hospital 43,000 wounded have gone, and there are three other clearing hospitals in Bailleul! No wonder Colonel Gallie is busy with his trains to and from Boulogne. I looked at the men's tags to see where they had come from—that is, from what field hospital—and was again disturbed to see how flimsy, insecure, and illegible the labels were—attached to a button merely by a slit in the tag. There has been 300 “gassed” victims admitted here in the past twenty-four hours, and all told they have received 1,000 cases since this business began, with about 30 deaths—not so bad after all—at least for those who manage to get back this far.

I gather that the English system of evacuating the wounded, not unlike the French, corresponds with the printed regulations prepared before the war, except that at present there is no need of stationary intermediate hospitals between the clearing hospital and the temporary overseas base hospitals at Boulogne and Rouen. The wounded are either brought off the fields by the regimental stretcher-bearers, or else they make their own way at nightfall as best they can to a regimental aid post, which, like the poste de secours [relief posts] of the French, is merely a place of temporary refuge in a copse, a dugout, or the cellar of a ruined building somewhere. Here their first dressings are usually applied, or first aid, such as in rare instances may have been given on the field or in the trenches, is supplemented. Thence by hand cart, or some horse-drawn vehicle, or possibly even by motor, they reach a field ambulance or dressing station which, like the ones we are to visit at la Clytte, corresponds to the ambulance de premiere ligne [of the first line] of the French and is in the zone of battle. From there the wounded are taken in turn by motor ambulances to such a clearing hospital as this in Bailleul; thence by a hospital train to Boulogne; then via Boulogne-Folkstone by hospital ship to “dear old Blighty,” to a hospital train again, to a general hospital somewhere, to a convalescent home, whence comes a final discharge, or back into service, as the case may be.

The main aim, of course, is rapid evacuation of wounded from France, and I am told that wounded have been known to reach St. Thomas's Hospital in London, eighteen hours after they have been in action. Yet in this particular sector, in which we are, it is a variable three miles or so from the aid station to the field ambulance, another six or seven to this clearing hospital, and about fifty-five from here to Boulogne. Of course, the character of work of a clearing hospital such as we have seen is largely one of classification and proper distribution, and though its capacity may be small, say 200 beds, 1,500 wounded may easily pass through in a day.

Reproduced from: Cushing H. *From a Surgeon's Journal, 1915–1918*. Boston, Mass: Little, Brown and Company; 1936: 66–68.

eral” or “stationary” hospitals. Their medical support rivaled that of large nonmilitary hospitals, accommodating 500 to 1,000 casualties. A few hospitals occupied large buildings, such as hotels and casinos. Although base hospitals were similarly well-equipped and managed relative to their civilian counterparts, they were highly specialized in the services they offered. For instance, at each base, one hospital dealt solely with infectious diseases, while the remainder accepted other aspects of specialty care, including dermatologic, maxillofacial, neurologic, ophthalmologic, orthopedic, and eventually chemical casualties. Nevertheless, these specialty care hospitals were always prepared to admit less-specialized casualties.¹⁹

When sulfur mustard made its first appearance, the British medical staff was unaware of the blistering effects of a vesicant, and most believed that the casualty presentation was linked to an infectious etiology (eg, scarlet fever). In his journal, Cushing noted his initial impressions when the new category of chemical agent appeared (Figure 3-9):

Poor devils [mustard gas victims]! I've seen too many of them since—new ones—their eyes bandaged, led along by a man with a string while they try to keep to the duckboards [narrow planks laid on top of the mud]. Some of the after-effects are as extraordinary as they are horrible—the sloughing of the genitals,

EXHIBIT 3-3**EXCERPT FROM "TAKE ME BACK TO DEAR OLD BLIGHTY!"—A POPULAR BRITISH WARTIME SONG**

Take me back to dear old Blighty!
 Put me on the train for London town!
 Take me over there,
 Drop me ANYWHERE,
 Liverpool, Leeds, or Birmingham, well, I don't care!
 I should love to see my best girl,
 Cuddling up again we soon should be,
 WHOA!!!
 Tiddlely iddley ighty,
 Hurry me home to Blighty,
 Blighty is the place for me!

Reproduced from: Mills AJ, Godfrey F, Scott B. *Take Me Back To Dear Old Blighty*. London, England: Chappell Music; 1916.

for example. They had about twenty fatalities out of the first 1,000 cases, chiefly from bronchial troubles. Fortunately vision does not appear to be often lost.¹⁴

American Expeditionary Forces Medical Organization

Faced with the need to respond rapidly to the chemical battlefield, the AEF based its medical support organization on the British system. On June 13, 1917, while the general staff in the United States struggled to organize, staff, and equip an army, General John J Pershing, commander of the AEF, and his personnel arrived and settled in Paris, followed by the first American troops several weeks later. General Order No. 8, published on July 5, 1917, established the organization of the AEF general headquarters, including the "chief of the gas service."²² The medical division originated in July 1917 when the Bureau of Mines established a laboratory for the study of toxic gases at Yale in New Haven, Connecticut, at the urging of Dr Yandell Henderson, an expert on oxygen rescue equipment. The laboratory was staffed by several scientists from around the country.²³

On July 24, 1917, the chief of staff ordered the Medical Department to provide nine officers as instructors for a gas defense school to be organized at the infantry school of musketry at Fort Sill, Oklahoma. As a result,



Fig. 3-9. This photograph is frequently held to show the inhumanity of chemical warfare; however, very few mustard casualties developed permanent eye injuries, let alone blindness.

Reproduced with permission from: Marshall SLA. *American Heritage History of World War I*. New York: NY: Simon and Schuster; 1964: 167.

the Medical Department was tasked with conducting defensive gas training, placing MOs without gas warfare experience in charge of training other MOs for duty as instructors (Table 3-3).²⁴

On August 17, 1917, General Pershing sent a cable to Washington requesting the organization of a gas service and the authority to appoint Lieutenant Colonel Amos A Fries of the Corps of Engineers as its chief (Figure 3-10). On August 22 Fries began building an organization based on specialized British and French units. Additionally, staff officers gave Fries a draft of a proposed General Order No. 31, which established

TABLE 3-3**MAJOR DEFENSIVE CAMPAIGNS OF THE AMERICAN EXPEDITIONARY FORCES, 1918**

Dates	Campaign
March 21–April 6	Somme Defensive
April 9–April 27	Lys Defensive
May 27–June 5	Aisne Defensive (Chatieau-Thierry, Belleau Wood, Vaux)
June 9–June 13	Montdidier-Noyon Defensive
July 15–July 18	Champagne-Marne Defensive (Second Battle of Marne)

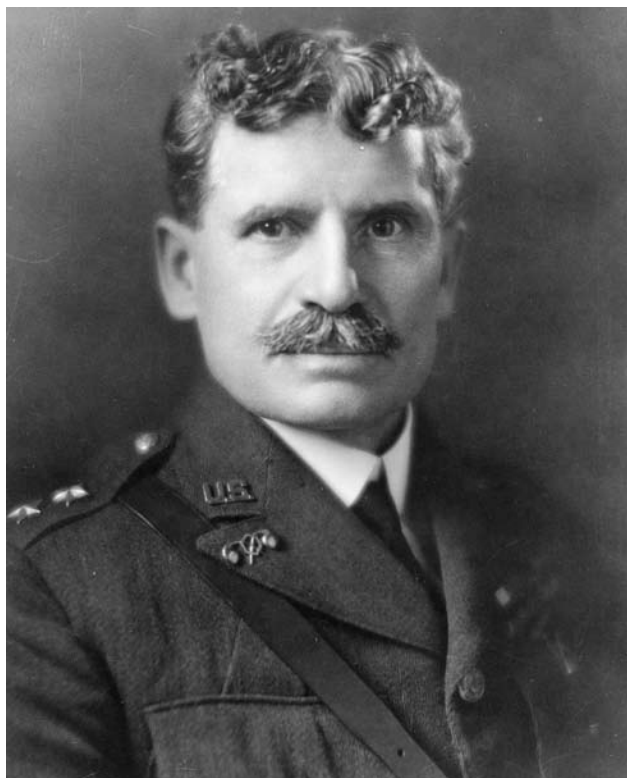


Fig. 3-10. Lieutenant Colonel Amos A Fries, shown here as a major general, was instrumental in organizing the chemical warfare service as it evolved in France.

Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

a gas service responsible for both offensive and defensive operations, including gas personnel, gas warfare training, and gas warfare logistics in the AEF.²⁵

On August 31 the surgeon general created a gas defense service composed of three sections: field supply, overseas repair, and training. He placed a Medical Corps officer in command and filled the staff with members of the Medical Department's Sanitary Corps (the equivalent of today's Medical Service Corps). The officers had no chemical warfare doctrine to guide them; only two existing War Department publications could be of use: *Notes on Gas as a Weapon in Modern War* and *Memorandum on Gas Poisoning in Warfare with Notes on its Pathology and Treatment*, both provided by the Army War College. These documents appeared to have borrowed extensively from French and British gas warfare doctrine.²⁶

The US Army's CWS was established on May 11, 1918, with Major General William L Sibert as the first chief. The CWS's overseas division was known as the Gas Service, and Major JR Church was its first medical

director in France. Church had assisted in the initial planning for the Gas Service, and as medical director he devoted most of his time to organizational matters. The increase in gas casualties, however, resulted in a personnel change in the position, with Lieutenant Colonel Harry L Gilchrist replacing Church (Figure 3-11). Gilchrist prepared for his new assignment by attending the British gas school in Rouen, France.^{23,27}

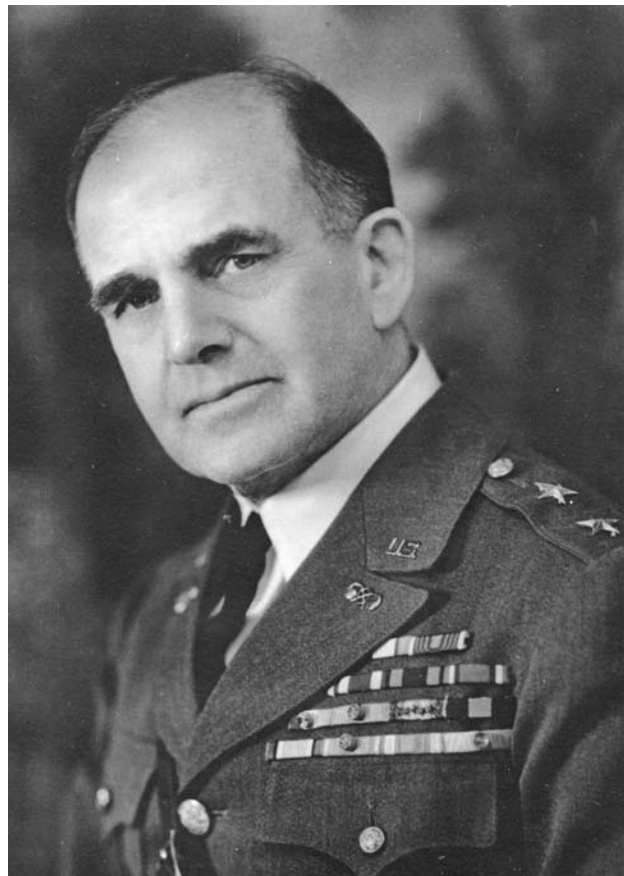


Fig. 3-11. Lieutenant Colonel Harry L Gilchrist (1870–1943), shown here as a major general in the Chemical Corps, was a preeminent figure in the history of the US Army's medical management of chemical casualties. As a Medical Corps officer, he was the second medical director of the Gas Service (overseas component) of the American Expeditionary Forces (AEF) in France in 1917–1918. He was responsible for the evolution of chemical casualty care within the AEF in Europe. Later, at Edgewood Arsenal in Maryland, he taught Medical Corps officers a course in the medical management of chemical casualties. Eventually, he transferred to the Chemical Corps, serving as its chief from 1929 to 1934.

Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

Finding nothing to define his position when he reported for duty, Gilchrist made his first priority to spearhead chemical casualty management education for AEF MOs. On February 9, 1918, Gilchrist published a pamphlet titled "Symptomology, Pathology and General Treatment of Gas Cases," containing basic information on the medical management of chemical casualties. Following this publication, the medical director's office issued a constant stream of bulletins aimed at keeping AEF MOs current on the latest medical developments in chemical warfare. Gilchrist visited most AEF divisions and hospitals, where he lectured on chemical warfare from a medical perspective, emphasizing the prevention and treatment of chemical casualties (Figure 3-12). Gilchrist also visited the sites of battles where large numbers of gas casualties had occurred, as well as hospitals, hospital trains, and other locations, comparing their efficiency and relaying his findings to both the Gas Service chief and the Medi-



Fig. 3-12. In this posed instructional picture of a World War I gas attack, the soldier on the right has removed his small box respirator and is inhaling poison gas. This photograph reminds soldiers that removing their masks in the presence of chemical agents leads to injury. Gilchrist pointed this out in 1928: "Investigation showed that these casualties were caused by general lack of gas discipline. It was found that the standing order that 'Men will not remove the mask until ordered to do so by an officer' was absolutely disregarded by practically all units affected, and that fully 75 per cent of the casualties were due to the disobedience of this order, casualties which efficient training and discipline would have prevented." ¹ Gas mask discipline was the key to low chemical casualty rates in the face of chemical weapons.

(1) Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Edgewood Arsenal, Md: Chemical Warfare School; 1928: 16.

Reproduced from: Moore WE, Crussell J. *US Official Pictures of the World War*. Washington, DC: Pictorial Bureau; 1920.

cal Department. He also assisted medical researchers in developing new treatment techniques for chemical casualties. His approach emphasized combating the effects of enemy chemicals therapeutically and prophylactically.²⁷

When the AEF's 1st Division began encountering German chemical attacks, no actions were initially taken to provide division medics with additional training in the treatment of chemical casualties, and they were unprepared to handle the sudden influx of chemical victims. In the confusion of organizing and placing an American army in combat, it took the AEF until October 1918 to establish a uniform procedure to handle chemical casualties.^{19,28}

Because the AEF division was on the ground long before the evolution of the corps and army organizational structure, the medical structure to treat chemical casualties first evolved within the division. Later, when the AEF army and corps evolved, so did their medical organization. On March 1, 1918, the 42nd Division became the second American division to occupy a sector on the western front. Although initially the division had few chemical casualties, the divisional MOs prepared for a large influx of victims. All four of the division's field hospitals were set up to accept chemical casualties, with a total of 500 beds dedicated to such cases.²⁹

At 5:30 PM on March 20, approximately 400 German mustard rounds landed on a position held by the division's 165th Infantry.³⁰ In the space of a few minutes, the vesicant caused 270 casualties, including one death. The initial aid station through which the casualties passed also became secondarily contaminated with chemicals. Medical personnel had to wear masks as they treated the casualties.^{31,32} The weather conditions enhanced the agent's persistence; it had rained earlier and there was no breeze to dissipate the vesicant as it hung in the air. At midnight, soldiers began to suffer delayed effects. One company (Company K) lost two thirds of its effectives. A week later, Gilchrist reported 417 gas casualties from the 165th Infantry at a base hospital.³⁰

As the intensity of fighting increased, so did the number of chemical casualties. Medical organization systems became taxed. Many shell-shocked soldiers suffering from exhaustion and hunger believed themselves to be chemical casualties. Some panicked after smelling shell fumes, reporting themselves gassed, and some feigned being gassed. "The symptomology of gas poisoning is so complex," observed Major William V Sommervell, a gas officer of the 3rd Division, "and at the same time so indefinite" that anyone who claimed to be gassed was immediately processed to the rear.^{24(p65)} One division field hospital commander

established a board to review the 251 chemical casualties in his wards. The board's report indicated that only 90 were truly chemical casualties.²⁴

Division medical personnel devised several techniques to detect and thwart suspected malingerers. Because front line troops were observed to always be hungry and true chemical casualties presented with decreased appetite, one approach was to offer the alleged chemical casualty a large meal. A "chemical casualty" who devoured the food was promptly returned to the fight. Medical personnel also offered suspected malingerers a cigarette laced with diphosgene; gagging was a sign the soldier was pretending to be poisoned.²⁴

As a result of continued chemical attacks, the 42nd Division, second only to the 1st Infantry Division as the most experienced American combat division of the AEF, took several measures to improve the management of chemical casualties. These measures became the standard for all AEF divisions on the line. The first measure was to dedicate one of the four division field hospitals to chemical cases. The position of a division gas MO was also created. The 42nd Division published Memorandum No. 148 on April 23, 1918, listing this officer as the instructor of medical personnel in gas defense. The gas MO also supervised gas protection of the medical dugouts, aid stations, and field hospitals, and made an early diagnosis of symptoms to treat all types of gas casualties.³²

The AEF adopted the 42nd Division's practices when it instituted the position of division gas MO for all AEF divisions (General Order No. 144, dated August 29, 1918³³). General headquarters took this measure in the face of mounting chemical casualties and a high incidence of related malingering throughout the AEF. As a consequence, in addition to the gas MO duties indicated in Memorandum No. 148, the AEF ordered additional duties, such as instructing all division personnel on the early symptoms and treatments of gas poisoning and instructing line officers in practical medical matters connected with chemical warfare. The orders stated that selected officers must be "live, wide-awake, energetic men, and must show a keen appreciation of the work." By the first week in October 1918, each AEF division had a gas MO who was sent to the University of Paris' gas school for a 4-day course in preparation for division duties.^{24,33}

The AEF organized the First Army in the fall of 1918. The general direction of the medical service was then executed by the chief surgeon of the AEF.³⁴ At the level of the field army, the chief surgeon performed as an advisory officer and established the following administrative divisions: hospitalization, sanitation and statistics, personnel, supplies, records and correspondence, and gas service.³⁵

Specialization was one of the issues addressed early by the chief surgeon. Specialized hospitals required many teams of personnel, including those trained to function as gas teams. These teams were usually organized from the personnel of the field hospitals themselves or were obtained from other Medical Department units of the division.

Some AEF hospitals were new and had not seen active service in combat before July 1918. Most of the mobile hospitals had been organized and equipped in Paris during July and August, and several of the evacuation hospitals did not reach France until shortly before the Saint Mihiel offensive. Although every available hospital unit in France was assembled, the inexperience of some and the limited equipment of others caused considerable apprehension about the adequacy of medical support.³⁶

In the defensive position, the front line was usually little more than a line of lightly held outposts, with the remainder of the troops supporting trenches or in reserve. Sometimes, as in the 5th Division in the Vosges, a battalion held a frontage of 5 km (3 miles).²⁸ One battalion surgeon was usually on duty with the advance troops, while the other was in charge of the battalion aid station. Two medics were normally assigned to each company at the front and staffed what was, in effect, a company aid post located at some sheltered point and near a communicating trench to the rear.^{37,38}

Company Aid Posts

The company aid post was frequently provided with equipment such as litters, splints, bandages, dressings, whale oil, sodium bicarbonate, and a few drugs. The medics were ordered to promptly adjust the respirators of chemical casualties. Those disabled on the front line were habitually brought to the company aid post (if necessary, on litters carried by company bearers), except when their wounds had been dressed where they fell and it was easier to remove them directly to a battalion aid station.^{39,40}

Battalion Aid Stations

At the battalion aid station, chemical casualties were stripped of contaminated clothing, bathed, and reclothed. Normally there was one battalion aid station for each battalion, located near the communication trench to the rear in a support trench from 240 to 500 yards from the front, utilizing any shelter available.⁴¹ One room in the aid station was for receiving casualties, one was for applying dressings and administering treatment for shock, one was for the battalion surgeon, one was for medical logistics, and one or more were

for the station personnel. The aid station could accommodate 30 casualties, but rarely received more than 12.^{37,38} A separate dugout at one side typically contained two rooms for the bathing, emergency treatment, and reclothing of chemical casualties. The doors to the dugouts were generally 3 feet wide and were protected by two tight-fitting blanket curtains placed at least 8 feet apart. The curtains, soaked with alkaline, glycerin, or sometimes hexamethylenamine solution, were adjusted so they would fall into place upon engaging a release. The first curtain was intended to be shut before the second was opened. It was hoped that the curtains would sufficiently gas-proof the dugout. A hand-pumped fire extinguisher filled with a sodium thiosulfate solution was used to neutralize chlorine (Figure 3-13).^{20,21,37}

However, gas-proofing with two blankets made it difficult to rapidly exit a dugout, so early US manuals advised against gas-proofing front line dugouts. This advice was generally unheeded because the advantage of having a chemical-free environment in which to sleep and occasionally remove protective masks outweighed the risk. The same Army manual stated that

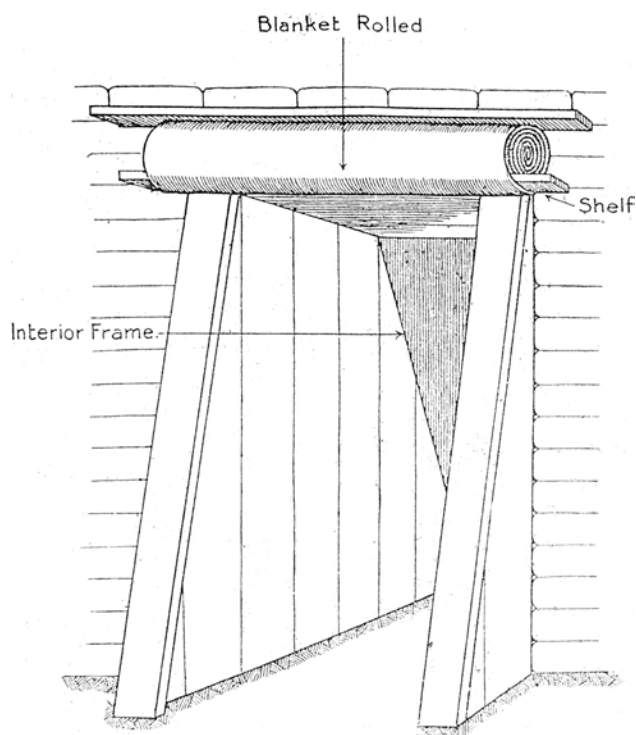


Fig. 3-13. Early attempts at collective protection during World War I included the dugout blanket, which was used to cover the doorways to dugouts.

Reproduced from: Army War College. *Methods of Defense against Gas Attacks*. Vol 2. In: *Gas Warfare*. Washington, DC: War Department; 1918.

“medical aid-posts and advanced dressing stations; Company, Regiment, and Brigade Headquarters; at least one dugout per battery position; Signal Shelters and any other place where work has to be carried out during a gas attack should always be protected.”^{20,21}

The personnel on duty at a battalion aid station normally consisted of an MO, a dental officer if available, and from four to six medics. These were often supplemented by two runners and a litter squad assigned from an ambulance company. The number of litter squads was increased if unusual activity was anticipated and equipment and supplies to support casualty respiration were necessary. Battalion equipment beyond that furnished by logistics tables included equipment for managing chemical casualties, such as two 500-L oxygen tanks, suits of overalls, gloves, and masks for attendants caring for chemical casualties, gas fans, alkalis, and sprayers used to clean out the galleries that chemical agents had penetrated.⁴²

Aid stations were established in banked earth, abandoned cellars, or dugouts because in the offensive phase there was no time to construct elaborate shelters. For the most part, the aid stations were small, dimly lit, and poorly ventilated. Medical personnel on duty in the aid stations were continually exposed to off-gassing from the chemical casualties. When hospital facilities were limited, one small building was used for dressing purposes and another for treating chemical casualties. After treatment, casualties were managed in tents or on litters in the open.⁴⁰

In the absence of sufficient equipment and water, an effective method was developed for bathing chemical casualties. Under a shelter, rows of inclined planes were constructed by placing litters on wooden trestles of unequal height. The litters were covered with rubber blankets that drained into buckets at their lower ends. Above, suspended from wires, were flushers for the eyes, nose, and ears. Watering pots containing a strong soap (alkaline) solution were used for the face. The staff was protected by chemical protective clothing and gloves.⁴³ At some hospitals, only selected casualties could be bathed and given special mouth and eye treatment because of water restrictions. Care at the battalion aid station was similar to that given at equivalent stations in the trenches: wounds were redressed and splints were adjusted, if necessary; hemorrhage was checked; and shock was controlled as much as possible. Chemical casualties were given as much relief as practicable.

Ambulance Company Dressing Station

At the minimum, the functions of an ambulance company dressing station were to receive, triage, and treat casualties (control hemorrhage, treat shock, and

process chemical casualties). As in the British system, the ambulance dressing station was established at the farthest point forward that ambulances could reach with reasonable safety. Casualties were selected for evacuation to supporting hospitals at the ambulance dressing station.³⁰ Supported by an ambulance service, casualties were transported directly to the appropriate hospital. A regulating station was often operated in conjunction with the dressing station, and ambulances were parked nearby.⁴⁴

Routes to dressing stations were often shelled and bombed, so ambulances began carrying chemical defense equipment. The following articles were added to the regulation equipment of the 42nd Division: coats (gas, 2 each); masks (M2 French, 4 each); mittens (gas, 2 each); and small oxygen tanks with connectors (4 each). The 42nd Division also provided three gas-proof shelters for dressing stations from 2.5 to 3 miles behind the front, each accommodating 20 casualties, with facilities for bathing and treating shock, hemorrhage, and other symptoms.²⁹

The number of dressing stations in a division rear area varied from one to three, according to the width and activity of the sector. Organization of the dressing station varied considerably, being most elaborate in the comparatively few divisions that used this formation as a triage station. The station consisted of specific departments involved in chemical casualty management.²⁹ Casualties arrived at a receiving and forwarding department divided into two sections that addressed triage and transportation. The personnel conducting triage were, in part, the divisional consultants (eg, the divisional chief of surgery or a representative, orthopedist, psychiatrist, urologist, tuberculosis expert, and gas treatment officer).³⁷

Chemical casualties, triaged into the first classification along with miscellaneous sickness, psychic disorders, venereal diseases, skin diseases, and convalescents, were separated. The gas department was located in an isolation room for wound-dressing purposes. Here, under direction of the divisional gas officer, chemical casualties were stripped, bathed, and clothed with such attire as could be obtained from the salvage section. Some chemical casualties found their way into the second classification, which ranged from malingerers to those with fatal wounds. The sick, the gassed, and those suffering from gas fright were classified as "seriously disabled," and were immediately evacuated or retained until they stabilized. In the 1st Division, dressing-station supplies were supplemented by additional chemical defense supplies, such as "antigas" suits and gloves and sodium bicarbonate (for vesicants).⁴⁵

Division Triage Stations

Each division of the First Army established a triage station that received, classified, and distributed evacuees. Medical specialty personnel, including the division gas MO, were assigned to each triage station. Divisions triaged a large number of casualties classified as "war neuroses," varying from shell-shock cases to shell fright, gas fright, hysteria, mental and physical fatigue, malingering, and cowardice.³⁸ Many division hospitals employed a psychiatrist to assist with differentiating these cases.

The organization for managing chemical casualties was specific. A corps medical gas officer served as a specialty officer to the corps surgeon. As with all specialty officers, the gas officer circulated constantly throughout the divisions within the corps to aid in chemical casualty management and was responsible for supervising the division medical gas officer.⁴⁶

Evacuation Hospitals

The evacuation hospital was located near outbound transportation routes such as paved roads or railheads. The preferable location was as close to the front as possible, yet safe from direct or indirect artillery fire—usually a distance of 15 to 25 kilometers (9 to 15 miles) from the line.⁴⁷ Mobile hospitals, including supplemental Red Cross base hospitals, were often provided for personnel. Supplementary professional groups provided for special patients in the evacuation hospitals, namely contagious, neurological, and chemical casualties. Sometimes special wards for these patients were set aside in the hospital. A registrar recorded, among other things, daily gas casualties. Chemical casualties were classified, if possible, according to the kind of chemical agent used. The classification for all patients was made according to the condition from which patients were suffering, whether they were sent out recumbent or sitting, and whether they were commissioned or enlisted. Chemical casualties could fall into any of these categories.⁴⁸

Other than administration, distinct departments of an evacuation hospital provided specific services. Included among the receiving ward, dressing tent, preoperative ward, radiograph room, examination room, operating rooms, sterilizing room, pharmacy, laboratory, dental clinic, and shock ward were the wards for special casualties, including medical, surgical, and chemical casualties. Chemical casualties were classified as medical and were sent to the appropriate wards or to neighboring units that provided for such patients exclusively.^{48,49} If casualties were retained and their conditions warranted, they were sent to their des-

tinations via the bathhouse. There, chemical casualties were treated or bathed with alkaline soap and solution. Otherwise they were bathed in the ward. Retained patients were furnished with pajamas; evacuated patients and those returned to duty were given fresh clothing and sent to the evacuation ward.⁴⁸

Base and Gas Hospitals

The organization of gas teams at base hospitals was authorized by the AEF's chief surgeon on June 2, 1918. Each team consisted of an officer, two nurses, and two enlisted soldiers. A course on degassing instruction was provided at the central laboratory at Dijon for officers designated to perform degassing service.⁵⁰ The gas team's mission was established as an additional duty. If the hospital received chemical casualties, degassing teams (usually three soldiers) were organized under the chief of the medical service but were under the direct supervision of another officer. Degassing teams were relatively permanent and functioned like receiving and evacuating departments.⁵¹

Gas hospitals had to support special treatment for chemical casualties. They were located near a water source because persistent and even nonpersistent agents clung to clothing, hair, and skin. The 2nd Division's gas hospital bath house had a portable heater and six shower heads. After admission to a hospital, soldiers stripped off their clothing and showered. Casualties with serious symptoms were bathed while still on litters. When soldiers left the showers, medics sprayed their eyes, noses, and throats with bicarbonate of soda. Depending on the diagnosis, patients might be given a special treatment of alkaline, oxygen, and, if necessary, venesection to counteract the effects of inhaled gas. Doctors prescribed olive or castor oil to coat the irritated stomach linings of soldiers who had ingested food or water contaminated by gas. When treatment failed to allow free breathing or when patients developed additional symptoms, medics immediately evacuated them to a base gas hospital.²⁴ Because of the shortage of medical personnel, ambulance personnel were often temporarily used to relieve overworked and understaffed gas hospitals.⁵²

Division Field Hospitals

When possible, division field hospitals were located in the same general area as base and gas hospitals, with one hospital officially designated to handle chemical casualties. Soldiers were placed into one of the following categories: severely gassed (immediate or expectant); fit for duty, immediate return to unit (minimal); fit for duty in 24 hours, return to unit (de-

layed); or evacuate to an Army hospital. Exhausted soldiers who complained of gas symptoms but who showed no outward signs of having been gassed were held in the division rear for rest, food, and observation. If medics verified their claims of gas poisoning, they were evacuated.³² In open warfare, field hospitals were usually located from 4.8 to 9.6 km (3 to 6 miles) from the front. This site was often determined on the basis of the routes of ingress and egress. Because in open warfare field hospitals had a paucity of fixed structures, they often operated out of tents. In many divisions, field hospitals were so near the front that they were easy targets for enemy shells.⁵³

Although by design field hospitals were specialized, they were expected to care for casualties outside specializations, as seen in the May 16 report of Field Hospital No. 2, which was managing 3 sick and 189 chemical casualties (98%). Field Hospital No. 3 reportedly managed 123 sick and wounded and 159 chemical casualties (56%), Field Hospital No. 12 managed 24 sick and wounded and 43 chemical casualties (64%), and Field Hospital No. 13 managed 37 sick and wounded and 37 chemical casualties (50%).⁵⁴

Casualties began arriving at division field hospitals shortly after the onset of the Aisne-Marne offensive in July 1918. From July 22 to August 11, one ambulance company evacuated 1,860 casualties, including medical personnel, of which four were chemical casualties. The field hospital at Ville Chamblon received chemical casualties of the 3rd Division, but only a few of these were severely affected; most of the chemical casualties that initially arrived were sneezing or vomiting from gas intoxication (riot control agents). Phosgene casualties presented later. Mustard casualties began to appear after German counterattacks.⁵⁵

During the summer and fall of 1918, the Second Corps fought with the British in Flanders in two phases. The corps made its medical personnel familiar with conditions in the British section of the western front, providing lectures and practical demonstrations that covered the medical management of chemical casualties, methods employed for transporting the wounded, the selection and operation of lines of evacuation, the treatment of water for drinking purposes, and related topics.⁵⁶ By September 1918 the field hospitals of the 2nd Division had become specialized, and the permanent triage station carried portable baths with both tubs and showers, gas soap, soda, and extra pajamas and underwear for reissue. The remaining field hospital was equipped to medically manage chemical casualties.⁵⁷

With the reduction of the Saint Mihiel salient, the front became so vast and the objectives so diverse that a single army could no longer manage alone, so the

AEF created the Second Army. By mid October 1918, chemical casualty management was becoming more routine. The Fourth Corps' Field Hospital No. 34 (the triage station) received 3,121 patients, including 935 chemical casualties (30%), while it operated at the front. Field Hospital No. 35 practiced routine chemical casualty management for all chemical casualties who had not been treated at the dressing stations. These casualties were undressed by personnel wearing protective ensembles. Chemical casualties' eyes were treated with a saturated solution of boric acid or a 1% solution of sodium bicarbonate, followed by liquid petrolatum. Casualties were then transferred to rooms where they were bathed first with soap and water and then with a 2% solution of sodium bicarbonate. They were dried, warmed, given hot drinks, and taken to a ward. After receiving treatment, patients usually slept for 24 hours.⁵⁸

In the Third Corps, two companies of the 1st Gas Regiment were assigned in support of offensive chemical operations. Chemical casualties were to be sent to the gas hospital at Souhesme le Grande.⁵⁹ The few chemical casualties from corps troops were sent to an improvised gas hospital at Rambluzin.⁶⁰ In the 4th Division, one field hospital was located as far forward as possible to receive, classify, and distribute all patients from the front. A field hospital for the primary treatment of chemical casualties and one that received slightly gassed and doubtful cases were nearby. The gas hospital was augmented with a mobile degassing unit.³⁹

Experience on the eastern border of the Argonne Forest demonstrated the difficulty of carrying "anti-gas" medical equipment to the forwardly positioned battalion aid stations, as well as the impracticality of administering antigas treatment to patients in these exposed areas. The nearest point at which such treatment could be given effectively was the more rearward dressing station. Even there, only the most acute management could be addressed. It was observed that, in many cases, chemically contaminated clothing could be removed at a dressing station, thereby preparing the chemical casualty for "clean" evacuation to the field hospital, where more elaborate antigas equipment was available.⁴⁵ The commanding officer of Field Hospital No. 328 gave the following description of his establishment at Apremont:

The hospital in the forest 1 km southwest of Apremont was situated back about 200 yards from the main highway and connected with it by an excellent road. It occupied nine wooden buildings, a large dugout, and an abandoned ward tent. All, in excellent condition, were wired for electricity and provided with many modern conveniences. A complete laboratory

and dispensary were found intact. The immediate vicinity of the hospital was strewn with equipment, dead horses, and a few dead men. During the first 24 hours 480 patients were admitted and evacuated.

On October 13 Field Hospital 326 joined to act as a gas hospital, operating under canvas. With the exception of a lull of three days, the two following weeks saw an endless procession of wounded. The great majority of these were only slightly wounded and able to walk, with the result that the two wards set apart for these cases were exceptionally busy. The heaviest days were October 15–18, when the admissions and evacuations averaged one patient every one and a half minutes.^{61(p34)}

Withdrawing German forces often used persistent agents to deny terrain and contaminate personnel and equipment. To handle the resulting casualties, field hospital personnel performing triage were given guidance on how to establish a departmental "gas group." It was suggested that the following personnel comprise a triage group that would work a 12-hour shift: two MOs, two noncommissioned officers, two clerks, one stenographer, twelve litter bearers, two soldiers for kitchen detail, one ward attendant for each patient tent, and two soldiers for the dispensary and dressing room (Figure 3-14).⁶²



Fig. 3-14. This photograph from Gilchrist's study of World War I gas casualties has the following figure legend: "War photograph—An old ruin heavily contaminated with mustard. Warning sign on ruin; place guarded by troops to prevent entrance." Often contaminated sites were not so clearly identified.

Reproduced from: Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Edgewood Arsenal, Md: Chemical Warfare School; 1928: 26.

Army-Level Hospitals

Beyond the division field hospitals, each army established its own army-level gas hospitals. The first such installation began operation on August 29, 1918. Army-level hospital personnel were casuals, or officers and enlisted personnel loaned from base or evacuation hospitals or anywhere else medical personnel could be found. To meet the demands of the Meuse-Argonne offensive, the AEF's chief surgeon established five army-level gas hospitals with a total of 1,650 beds. Colonel Gilchrist suggested three mobile 1,500-bed gas hospitals be established, one for each US corps. This plan, however, was never implemented because of insufficient personnel. Another plan called for the creation of two "emergency gas teams" to be assigned to each base hospital. The mission of these teams was to "relieve the strain" that sudden chemical attacks put on division field hospitals. The AEF general headquarters organized several emergency gas teams, each consisting of an MO, two nurses, and two orderlies. The chief surgeon of the First Army, Colonel AN Stark, however, objected to these teams on the grounds that base hospitals were too far removed from the fighting; he believed that the division field hospitals set aside for chemical casualties were sufficient. Heeding Stark's objections, the chief surgeon disbanded the teams.²⁴

On August 2, 1918, a hospital center was organized west of Toul in the area called Le Rue Justice, near a railhead. The Justice Hospital Group was formed in part to meet the needs imposed by the Saint Mihiel operation, including managing chemical casualties. The provisional gas hospital was based at the Annex Caserne La Marche and was equipped with 650 beds. With the exception of Caserne Luxembourg, these barracks were situated close together on the Rue Justice, about 1.6 km (1 mile) from the center of the city of Toul.²⁴

Base Hospital No. 51 arrived in Toul on August 27 tasked to treat gas casualties. It was located near Evacuation Hospital No. 14 in a centralized group of four-story barracks and other buildings. These hospitals were prepared to receive chemical casualties and were provided with some supplies from French stores. Casualties were admitted to a receiving ward, where an MO sorted them into the following three classes: (1) walking wounded (sent to the dressing room), (2) gassed and medical cases (sent to special wards), and (3) wounded on litters (the majority; sent to a second triage or preoperative ward). These patients received 80% of the professional care given in the hospital.⁶³

Although the Justice Hospital Group's provisional gas hospital was formed to support the Saint Mihiel offensive, its personnel initially consisted of 3 per-

manent officers, 6 other officers, 14 nurses, 9 medical noncommissioned officers, and 50 soldiers from the training battalion depot at Saint Aignan. Forty more soldiers from that battalion joined on September 19. The gas hospital occupied the part of Caserne La Marche originally constructed for hospital purposes and used in peace time by the French as a hospital for the local garrison, so the buildings were perhaps better suited for hospital purposes than were other buildings of the Toul group.⁶⁴

The four buildings gave adequate provision for the designated 650 patients, with suitable rooms for logistical stores and service. A Bessonneau tent was used as a receiving ward and sorting station. A screened-off section provided for the immediate administration of oxygen or treatment by phlebotomy for casualties intoxicated by phosgene, and mustard gas casualties were sent to a building equipped with two French portable bathing machines supplied with running water (the marked shock of phosgene casualties and the sloughing of the respiratory mucosa of mustard casualties were the most pronounced symptoms in chemical casualties). Other buildings were used for an officers' ward, a place to treat mild vesicant casualties, and rooms for convalescents recovering from the effects of phosgene. From September 10 to October 7, 1918, the unit admitted 1,336 medical and 1,351 gas cases.⁶⁴

Evacuation Methods

The corps medical evacuation methods varied considerably between and within each corps, depending on the tactical situation (Exhibit 3-4, Figure 3-15). For example, in the 42nd Division, casualties were carried from the front line trenches by regimental medical personnel or by combat troops from the place of injury to the battalion aid post. There, casualty cards, called "diagnosis tags," were attached by the first MO or medic who treated the casualty. The forward-deployed medical personnel learned quickly to construct gas-proof dugouts in casualty care areas. This was essential for survival in a static defensive trench warfare scenario because of the prolonged nature of the attacks and the extensive employment of chemical agents. Casualties treated at aid posts were carried by litter bearers detailed from the ambulance section to the ambulance dressing station, which was located with a main dressing station.⁶⁵

In some instances, facilities permitting, chemical casualties were separated from other wounded soldiers.⁶⁵ The ambulance crews that brought chemical casualties to the advanced dressing stations needed appropriate chemical defense equipment. Extra gas masks were

EXHIBIT 3-4

HEADQUARTERS, FIRST ARMY CORPS, MEMORANDUM ON THE EVACUATION OF SICK AND WOUNDED, 1918

Memorandum: Evacuation sick and wounded.

The following plan of evacuation of sick and wounded for each division in the corps will be put into effect at once.

AMBULANCE DRESSING STATION

...

2. At this ambulance dressing station will be stationed the following medical officers in addition to the personnel of the ambulance section conducting the station: division psychiatrist, division orthopedist, division medical gas officer, and a medical officer with good surgical experience and judgment. Each of these officers should have an understudy who can relieve him when necessary to secure rest or food.

6. The division medical gas officer will examine all gassed patients, returning to the front line all deemed fit for duty. He will return to the rear all that require hospitalization. He will also supervise the preliminary gas treatment at this point. Bathing facilities will be provided so that mustard gas patients will get the earliest possible attention and thus prevent subsequent burning.

8. In past experience during open warfare, it has been found that large numbers of men return from the front diagnosed as shell shock or gas casualties. The great majority of these men present neither of the above conditions, but are simply exhausted, mentally and physically. They are disabled for the time being, but should not be sent to evacuation hospitals. They must be held in divisional sanitary organizations, given the necessary food, a bath when possible, and an opportunity to thoroughly rest. It will be found that within one to four days they will be able to return to full duty at the front, thus saving a very marked loss of man power when the maintenance of the man power of a division at its full strength is most important. Any such subsequently developing serious symptoms will at once be transferred to an evacuation hospital.

9. During active operations when the number of casualties becomes very large, it will be found that the available ambulance transportation will be entirely insufficient to carry all wounded to the rear and to prevent congestion of wounded in the front areas. It therefore is necessary for division surgeons to maintain liaison with the division motor transport officer and to secure the use of as many trucks as possible to carry back slightly wounded and gassed patients. Severely wounded and gassed must be carried in ambulances only. The corps surgeon will give every possible assistance to division surgeons during such periods of stress and will utilize for this purpose all available ambulances within the corps.

FIELD HOSPITALS

...

3. The field hospital will be utilized as follows: (a) Gas hospital, and (b) one hospital in reserve.

4. Gas hospitals: One field hospital will be utilized as a gas hospital. To this hospital will be sent from the triage all patients who have been gassed. Therefore, facilities must be provided to give them the necessary special treatment required—proper bathing, alkaline treatment, administration of oxygen and, if necessary, venesection. As soon as the necessary treatment has been given and their condition permits, such patients as require further hospitalization will be sent to the nearest evacuation hospital. However, during open warfare, it will be found as noted before that the majority of gassed patients or the so-called gassed, will not require anything beyond a few days' rest, sleep, and food. These must not be sent to evacuation hospitals but must be retained until fit for duty (provided this does not require more than four days) and then returned to the line. At this hospital, there will also be installed a shock table for the treatment of those needing shock treatment at this point.

7. One field hospital in reserve: This will be used to give assistance where needed both in personnel and equipment. A detail of 1 medical officer and 10 enlisted men will be sent to the ambulance dressing station to give the necessary preliminary bathing and alkaline treatment to patients with mustard gas burns as may be deemed necessary by the division medical gas officer on duty at this station.

Reproduced from: Lynch C, Ford J, Weed F. *Field Operations*. Vol 8. In: *The Medical Department of the United States Army in the World War*. Washington, DC: Government Printing Office; 1925. Chapter 18.



Fig. 3-15. This photograph from Gilchrist's study of WW I gas casualties has the following figure legend: "War photograph: Special gas aid station for administering to gas casualties. Here cases suffering from different gases were, when possible, segregated." The lack of protective equipment in the photograph suggests that the casualty being loaded into the ambulance was not deemed a threat, possibly because he was a victim of a respiratory agent. Reproduced from: Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Edgewood Arsenal, Md: Chemical Warfare School; 1928.

often carried in ambulances, and sometimes one or more French Tissot masks were added for the use of the driver.⁶⁶

By the time of the southern attack of the Saint Mihiel offensive on September 12, 1918, medical support provided for the initial treatment of chemical casualties near the front. Ambulances were forbidden to speed; although it was acknowledged that casualties should be transported as rapidly as possible, their arrival condition was severely compromised if their transport was hurried or if they did not receive adequate stabilization to prepare them for an ambulance journey (Figure 3-16). This was particularly true of those intoxicated by phosgene.⁶⁷

Throughout the occupation of the Toul sector, ambulances drove directly to battalion aid stations and carried the wounded to triage, almost without exception. Casualties tended to reach triage 1 to 3 hours earlier than expected. In one instance, casualties loaded near Norroy reached Evacuation Hospital No. 1 at Sebastopol barracks (40 miles) within 3 hours of being wounded, though it typically took an average of 4 hours to get a casualty from the place of injury to triage. Pulmonary and vesicant (inhalational) casualties who arrived without respiratory signs and symptoms in this 4-hour window had an excellent prognosis for recovery (Exhibit 3-5).⁵³

Part five of the Fourth Corps plan of communication, supply, and evacuation (Annex No. 4 of Field Order No. 14, dated Sept 6, 1918) determined that the divisional medical gas officer, psychiatrist, and



Fig. 3-16. This photograph, taken near Cheppy and Very, France, has the following figure legend: "War photograph—Special ambulances used for transporting mustard gas casualties rendered necessary due to insidiousness of mustard." These vehicles from Ambulance Company No. 13 supported the First Division. Reproduced from: Gilchrist HL. *A Comparative Study of World War Casualties from Gas and Other Weapons*. Edgewood Arsenal, Maryland: Chemical Warfare School; 1928.

orthopedist would perform triage. The medical gas officer would examine all chemical casualties and advise preliminary medical management as required. Casualties would be either hospitalized or returned to duty if fit. The psychiatrist examined all cases of shock or simulated shock and other nervous conditions. All troops designated for evacuation were directed to a gas hospital at the La Marche section of the Justice Hospital Group near Toul. All nonevacuated chemical casualties were to be managed in an established field gas hospital.³⁶ Although no specific plan for managing chemical casualties was presented, the following quote was recorded, which placed the medical logistical mission into context:

The difficulties to be met and overcome by the medical supply unit of a division are of a unique character. A fairly comprehensive idea of them may be formed if one will draw a mental picture of managing the only drug store in a city of 30,000 people, operating it day and night, and frequently, sometimes daily, changing its location. There are only eight clerks, for no more can be obtained, and transportation consists of two 3-ton trucks operating over congested roads. The community of which the unit forms a part is frequently bombed and shelled.^{29(p107)}

Evacuation in Trench Versus Open Warfare

In open warfare, the medical management (includ-

EXHIBIT 3-5

**SECRET FIELD ORDER NO. 41, ANNEX NO. 7, ISSUED BY THE FIFTH DIVISION,
SEPTEMBER 9, 1918**

The triage will be located at Camp-de-Cirque, eight hundred (800) meters north of the cross roads at St. Jean. Messages to the commander of the sanitary train and the director of ambulance companies will be sent to the triage by returning ambulances.

The following information will be sent:

(1) The number and location of wounded and gassed to be evacuated.

(i) Severe casualties will be evacuated by ambulance, preference being given as follows:

(1) Severe hemorrhage.

(2) Abdominal wounds, not in shock.

(3) Severely gassed.

(4) Wounds of thorax.

(5) Fractures.

(u) Hospital for nontransportable wounded and gassed and for slightly sick.

(1) The hospital for nontransportable wounded and gassed and for slightly sick will be located south of Domevre-en-Haye on the western side of the Manonville—Tremblecourt road. At this place there will be located Field Hospital #17 and operating team #17 for treatment of nontransportable wounded.

(2) Field Hospital #29 for treatment of gassed.

(v) Evacuation service for army and corps artillery:

Surgeons of artillery organizations operating in the 5th Division area exclusive of 5th Artillery Brigade will establish collecting stations for wounded and gassed along this road. They will notify the director of field hospitals at Domevre-en-Haye of the number of casualties and location of these collecting stations.

(a-1) Evacuation hospitals.

(2) At La Marche barracks, "The Caserne," just south of Toul. Hospital for gassed.

NOTE. Gassed and wounded patients will not be loaded in the same vehicle.

Reproduced from: Lynch C, Ford J, Weed F. *Field Operations*. Vol 8. In: *The Medical Department of the United States Army in the World War*. Washington, DC: Government Printing Office; 1925. Chapter 18.

ing evacuation) of chemical casualties on the battlefield and in field hospitals was very different from that observed when troops were in the trenches because all medical assets had to be deployed forward. Casualty evacuation required units to close in on the combat zone, placing medical assets closer to chemical weapons used by the enemy. In the beginning of the offensive against Soissons, one station within the 2nd Division was located within 50 yards of the enemy lines.⁶⁸

The methods of the sanitary train in open warfare also differed from those in trench warfare. Difficulties were magnified by prolonged enemy fire, increased road congestion due to the movement of troops and

supporting medical units, limited fixed facilities for logistics, increased numbers of wounded, a greater need for medical unit replacements, the inexperience of medical replacements upon arrival, and physical exhaustion caused by long-continued hard labor and exposure. Chemical agent casualties encountered longer evacuation times and were thus vulnerable to subsequent gas attacks.

One of the most conspicuous differences between trench and open warfare was in the way the ambulances and field hospitals conducted business. In open warfare, especially during the Meuse-Argonne operation, animal-drawn ambulances were more valuable than motorized ones and were much more

frequently employed, chiefly because they could traverse routes impassable to motor vehicles and bypass road obstructions. Chemical casualties could receive timely management if they were transported by animal-drawn ambulances because chemical agents used in World War I had an overall delayed effect, unlike nerve agents or cyanide (which appeared later) in which immediate treatment was necessary.

The second phase of AEF operations was fought primarily “over the top” in the offensive. The AEF units participating in the Aisne-Marne offensive in early summer were either under French or British command (Table 3-4).⁶⁵ In the early days of the AEF offensive, it was necessary to remove all litter casualties that required transportation from the aid station to a pick-up point a kilometer (0.6 mile) or more to the rear that could be easily accessed by ambulances. As soon as ambulances could evacuate directly from aid stations, congestion was no longer an issue.³⁹

Spanish Influenza

In mid June 1918 through mid July, Spanish influenza appeared on the battlefield and affected the degree of fighting during the defensive campaigns. It tapered off by the end of July, but reappeared in the offensive campaigns in October 1918.¹⁵ Influenza’s

attack on the pulmonary/respiratory system seriously affected military operations twofold, first, by reducing the number of healthy soldiers, and second, by taxing the capabilities of the sanitary trains. The chemical casualty patients in sanitary train facilities had compromised and vulnerable pulmonary systems by virtue of the mechanism of action of pulmonary (phosgene) and vesicant (mustard) chemical agents. The Spanish influenza of 1918 did not stop military operations in theater, but it slowed them noticeably. When its peak was passed, reinvigoration of offensive operations increased the already heavy strain upon medical support capabilities.⁶⁷

The First Army was hit hard by the influenza. Its chief surgeon reported 72,467 battle casualties in the Meuse-Argonne operation, of which 18,664 (25.7%) were chemical casualties.⁶⁹ It is possible that not all chemical casualties were reflected in the existing administrative records. Many chemical casualties passed through the hospital without being admitted to the gas ward. Some required surgical intervention for wounds and were categorized under other admission criteria. Others were so lightly gassed they were treated in other categories, including generalized respiratory diseases. The “gassed” category included nearly all those who had been incapacitated by mustard gas, which caused burns, conjunctivitis, laryngitis, gastroenteritis, and bronchitis.

TABLE 3-4

MAJOR OFFENSIVE CAMPAIGNS OF THE AMERICAN EXPEDITIONARY FORCES, 1918

Dates	Campaign
July 18–August 6	Aisne-Marne Offensive (Flanders Operations: Dickenbush/Scherpenberg)
August 8–November 11	The Somme Offensive
August 18–September 17 (November 11)	The Oise-Aisne Offensive
August 19–November 11	Ypres-Lys Offensive (AEF in Belgian French Sector)
September 12–September 16	Saint Mihiel Offensive
September 26–November 11	Meuse-Argonne Offensive, American Sector The Meuse-Argonne Champagne, AEF in British Sector (Phases I–III)

AEF: American Expeditionary Forces

Medical Personnel as Victims

Even medical personnel became victims of chemical attacks during the war. For example, Dr Eric P Dark, an Australian army physician, was on the receiving end of a chemical attack while managing chemical casualties (Exhibit 3-6). Dr Harvey Cushing also wrote of medical personnel who became chemical casualties:

Poor Telfer is all bunged up with a secondhand dose of this mustard-oil gas or whatever it is. Many more of these men were brought in last night; and as the orderlies were panicky, owing to the raid, he did a lot of handling of patients himself and to-night has a bad cough, swollen and lachrymating eyes—like the men themselves. One or two others who have handled and undressed gassed Tommies have got it too in mild form.¹⁴

In the AEF’s 78th Division, the regimental aid station of the 309th Infantry was located at Marcq, and its battalion stations were in Saint Juvin, about 1 km (0.6 mile) west, in the shelter of a hill. In this regiment, all but one of the MOs and most of the medical enlisted personnel were evacuated as chemical casualties. The regiment itself was so reduced in strength that line litter bearers could not be

EXHIBIT 3-6

THE ACCOUNT OF A CASUALTY: DR ERIC P DARK*

On the 16th [October 1917], I went up with 11 squads of bearers, and established a dressing station under a kind of lean-to against the wall of the block houses on the creek side. About midnight fairly heavy shelling began, and continued off and on till dawn, and there was a lot of general strafing all along the front. Probably the Germans were expecting an attack. Most of the German shelling must have been aimed at our field guns, but fell about 50 yards short, between the creek and the block houses. They mixed a lot of gas shells with the high explosive—one could tell the gas shell as it went off with a little plop, instead of the roar of the high explosive. Unfortunately a gentle breeze blew the gas back over our position.

Brigade, of course, had a gas sentry mounted who sounded the gas alert at appropriate times; certainly, all the men with me put on their gas masks the moment the alert sounded and did not take them off until the all clear. Looking back on it I think the sentry did not allow enough time for the gas to disperse, considering the very gentle breeze. I should probably have allowed a good margin for safety, but we had been told to depend on the sentry.

Wounded constantly came in, walking cases, and stretcher cases that the bearers brought from the forward area. No other MO. was with me so I was fully occupied with dressings. Just before dawn a heavy shell got a direct hit on one of the block houses, blowing it in, and seriously wounding two infantrymen. When I got there with a corporal, Sachs by name, and stretcher bearers, I found that both the men had compound fractures of the femurs (thighs).

We had our gas masks on, as the all clear had not yet sounded, and set about trying to fix the men up. In the conditions, with the men lying on the floor that was littered with smashed concrete, the air thick with the dust of the explosion, and our sight constantly blurred by fogged eye-pieces, it seemed impossible ever to get the wounds dressed and the fractures properly put up on Thomas's splints. After fumbling about for some time I made a decision, and told Sachs "Look Corporal we are getting nowhere; you and I will take off our masks so that we can do the job properly." He made no demur, and worked well and dexterously to help me get the men fixed and away.

It was a horrible night, and by dawn 32 of my 44 bearers were casualties, mostly gassed, ultimately 16 of them died, including Sachs, a good man, whom probably my order killed.

At dawn I went back to our advanced dressing station to report to Frazer, feeling very gloomy, there was the loss of the men, and there was my responsibility, for an officer was not supposed to let his men be gassed. Frazer did not say a word except "Bad luck; are you gassed?" He gave me extra bearers to clear the few remaining stretcher cases remaining to be shifted.

Some time about noon my relief came up as Frazer had promised (I had told him I wished to get the last cases cleared before being relieved). Abraham found me nearly blind from intense irritation and swelling of the cornea, and constantly vomiting. The gas had been a mixture of mustard and phosgene. He put me on a stretcher where I felt horribly exposed, hoisted on the shoulders of the four bearers, for shells still fell sporadically.

I reached the CCS fairly late in the afternoon, and there I was put in a small tent, and apparently forgotten, for I lay there until long after darkness came, hearing people pass, and hoping that some time someone would pick me up and put me into bed. I could still tell the difference between light and darkness, but by morning even that amount of sight was gone, and I was quite blind for four or five days; also I had a violent bronchopneumonia, spitting up quarts of thin blood-stained serous muck. They gave me other quarts of what they told me was sodium hyperchlorite, which was supposed to be helpful; anyhow it was not bad stuff. The nursing staff there were quite magnificent, constant attention, and everything I needed there on the moment.

*Dr Dark was gassed during the long Paschendale offensive, which began on August 31, 1917.

Reproduced with permission from: World War I: The Medical Front Web site. The WWI military memoirs of Captain Dark, MC, Australian doctor, Great War. Available at: <http://www.vlib.us/medical/dark/dark.htm>. Accessed February 9, 2008.

furnished, and the regimental band augmented medical support.⁷⁰ During the Aisne-Marne offensive, 50% of the

medical personnel casualties of the 3rd Division were caused by managing chemical casualties.⁵⁵

HISTORY SINCE WORLD WAR I

Chemical Training and Research

Although World War I ended on November 11, 1918, work on chemical agent exposure continued at the Edgewood, Maryland, medical research laboratories. The Army Medical Department spent more money on chemical weapons research than anything else during the interwar years.^{26,71-73} In 1922 Lieutenant Colonel Edward Vedder, a 1902 graduate of the University of Pennsylvania and a Medical Corps officer, was selected to become the chief of the medical laboratory at Edgewood (Figure 3-17, Exhibit 3-7).⁷⁴ Clinical cases were studied, animal research was performed with chemical agents, human experiments were conducted, and new treatments were tested in the Edgewood laboratories.



Fig. 3-17. Edward Bright Vedder (1878–1952) was director of pathology at the Army Medical School (now Walter Reed Army Institute of Research) from 1904 to 1913. During this period he wrote his seminal book on beriberi. After serving in the Philippines during World War I, Colonel Vedder returned to the Army Medical School in 1919, where he wrote a book on chemical casualties that remains relevant. From 1925 to 1929, he was chief of medical research for the chemical warfare service. He had an illustrious civilian academic career following his retirement from the Army. Photograph: Courtesy of the National Library of Medicine, Bethesda, Md.

Chemical training for soldiers gave way to chemical casualty management training for military physicians. Vedder was the first to establish a “course for medical officers,” the forerunner of today’s courses taught by the Chemical Casualty Care Division of the US Army Medical Research Institute for Chemical Defense. The early course was a 5-day event covering critical information for managing chemical casualties. Instructors for the course were influential CWS members: Colonel Harry Gilchrist (later general and commander of the Chemical Corps), Captain Alden Waitt (gas officer of

EXHIBIT 3-7

LIEUTENANT COLONEL EDWARD VEDDER

Edward Vedder deferred a clinical residency for a research fellowship to study bacteriolytic serum complement. As a member of the first graduating class of the US Army’s Medical School for Officers (an early version of Medical Officer’s Basic Course started by Surgeon General George Sternberg), Vedder was sent to the Philippines, where he developed his research and laboratory skills in the study of malaria, amoebic dysentery, dengue, and a host of other tropical diseases. In 1910, after finishing a clinical utilization tour, he returned to the Philippines as part of the Army board for the study of tropical diseases and focused on medical research involving beriberi. In 1913 he returned to the United States, where he worked in the laboratory at the US Army Medical School and taught serology and bacteriology. The United States became involved in World War I in 1917 and, along with Dr Franklin Martin (one of the founders of the American College of Surgeons), Lieutenant Colonel Vedder was selected to serve as the Army’s representative to a committee on education, where he was involved in the design of pocket manuals used to teach military physicians the medical management of war casualties (Medical War Manual No. 1, “Sanitation for Medical Officers”). In 1919 Vedder began a 3-year tour as the director of the Eighth Corps Area Laboratory housed at Fort Sam Houston, Texas. In October 1922 Army Surgeon General Merritte W Ireland established a medical research division as part of the Chemical Warfare Service at Edgewood Arsenal and selected Vedder to be its organizer and first medical director.

Data source: Vedder E. Fifty years of medicine. In: The Papers of Edward B. Vedder. Edward G Miner Library, University of Rochester Medical Center, Rochester, New York; Box 3, Folders 1–14. Chapter I.

the 29th Division and future major general and chief of the CWS), and Colonel Amos Fries (wartime chief of the overseas component of the CWS). Dr Gilchrist served as chief of the medical division of the CWS from 1922 to 1929. In 1925 Lieutenant Colonel Vedder published *Medical Aspects of Chemical Warfare*, a book containing data on the pathology and physiology of various chemical agents (particularly mustard). Much of the text is still germane. In it and his memoirs, Vedder expressed staunch support for chemical warfare:

Gas did not maim as did missiles, the wounds of which caused the loss of arms, legs, and the distressing destruction of the jaws and other wounds of the face. Chemical Warfare therefore, appeared to do the work of dissipating the opposing Army better than did firearms, and it was at the same time more human or at least less barbarous, and more economical. It required many fewer troops and much less money to produce sufficient gas than to secure fire control.⁷⁴

Leading into World War II, the organization for medically managing chemical casualties was based upon the World War I schemas. Despite the general expectation that chemical weapons would be used in World War II, smoke and flame were the only chemical agents used in the war (smoke was used for screening troops and movement, especially in Europe, and Americans in the Pacific used flame weapons in Japanese caves and bunkers). For reasons that historians are still debating (see Chapter 2), gas itself was not used, though the United States was prepared for a gas attack. In an address to the students of the Industrial College of the Armed Forces, Lieutenant General Alden Waitt, the CWS chief in 1946, commented on his discoveries and impressions as he visited the German heartland after the end of World War II:

The Germans had gases that were unknown in World War I, gases which were much more potent than World War I gases. They would have used them if we had not had protection against them and had not been able to retaliate in kind. I saw the tremendous preparations which the Germans had made for waging gas warfare. . . . We in the Chemical Warfare Service who were responsible for the program had been worried because we had not turned up any German gas as we moved through France and western Germany. A few of us who were responsible for the planning and establishing the requirements wondered if questions would be raised after the war as to whether we had been thoroughly justified in spending money of the Government and insisting that there be placed over in England quantities of gas for retaliation. No gas depots showed up when we came into Normandy. No German gas appeared in France. No German gas appeared before we got to the Rhine. But after we got

across the Rhine it began to show up in tremendous quantities, we discovered large stocks of gas in central Germany, scattered all through the country. The tremendous German effort and potential were apparent, once we had gotten into the central part of the country. After the surrender, when I saw these things, I realized that we had been well justified in all our preparations. As a matter of fact, we had won a gas war without firing a shot, without dropping a bomb. I saw the tremendous installations at Raubkammer—tremendous proving grounds, pilot plants, and depots. This one proving ground at Raubkammer was the equivalent of our Edgewood Arsenal and Dugway Proving Ground combined. It was equipped with splendid facilities. . . . I do not have time to tell you about them. I can only assure you that I was amazed at what I saw there. Several bomb-storage depots were located at Raubkammer. At Muna Ost, a few miles away, there was a storage depot for chemical mines and artillery and mortar shells. There was a tremendous quantity of munitions there. The Luftwaffe gas storage depot was located at Oerrel. Here I saw 175 beautifully camouflaged concrete bunkers all filled with 250-kilo and 500-kilo bombs charged with phosgene, mustard, and the new German gas, green ring 3—thousands upon thousands of bombs and all of them invulnerable against attack. We might, if we could have gotten a direct hit on one of these bunkers with a thousand pound bomb have destroyed it; but, only by a direct hit. They were beautifully hidden. As a matter of fact, we did not know of any of these installations until we got in there. They had not been located by allied intelligence. The same thing was duplicated all through central Germany. In all we located approximately a quarter of a million tons of toxic gas-munitions and bulk agent. What do you suppose they figured on doing with those quarter of a million tons—250 thousand tons, not pounds? What do you suppose they had that for? Why did they not use it?

The fact that we were prepared—that we had gas overseas in England ready for instant retaliatory use, and finally, that we had the great potential of our arsenals and industry, is why they did not use gas at Normandy when we landed. I am confident of this, and it is one of the best lessons in preparedness the American people can have. We prevented a gas war by being ready!

I am sure that a gas war would have set us back six months if they had dropped large quantities of gas on us when we were concentrated in small areas on the beaches in Normandy. I am just as sure of that as I am sure of anything. Had the gas appeared at Normandy, it would have delayed us seriously. It might have given the Germans time to get ready their V-3 or V-4 or whatever their next great technical development was going to be. But they did not dare to use it, because they knew if they did, their cities would have been drenched with gas.

I am not sure they made the right decision. I am not sure that the six months' advantage might not have been worth to them the terrific shellacking they would have gotten from our gas. It was a difficult decision. They decided not to use it. I am sure the only reason they decided not to use it was because they knew we were ready, and could retaliate heavily and effectively.⁷⁵

The Bari Disaster

Shortly after the 1943 disaster at Bari, Italy (see Chapter 2), Lieutenant Colonel Stewart Alexander of the US Army Medical Corps, the chemical warfare consultant on General Eisenhower's staff, was sent to Bari, where he made the diagnosis of mustard poisoning. He reported 617 cases in troops and merchant marine seamen, with a 14% fatality rate. This high fatality rate was nearly 3-fold that of the mustard fatality rate in World War I, largely because the merchant marine seamen had been thrown into the sea, where they either swallowed mustard in the water or were badly burned.^{68,76} Dr Cornelius P Rhoads, another physician involved in diagnosing and treating the casualties, observed chemically induced leucopenia among the locals.

Chemical Agents in Concentration Camps

Biological and chemical casualties and fatalities from Germany's experimental testing of chemical and biological warfare agents, including cyanide, mustard, lewisite, and nerve agents, were found at Dachau and Buchenwald. Camp Natzweiler-Struthof, the only concentration camp in France, used phosgene and mustard on inmates. Sachsenhausen Camp at Oranienburg, just north of Berlin, used mustard in experimentation on inmates, and Spandau University in Berlin was believed to have used nerve agents for experimentation. At the camp in Neuengamme, mustard was given to inmates to drink. The details of this kind of chemical agent use were explored by the United States in the Nuremberg and British war trials. After the defeat of the Nazi forces along the eastern front, the Soviet Army uncovered Auschwitz-Berkinau and saw how Zyklon B, a rat poison, had been used in specially constructed gas chambers for the purpose of mass human extermination. Before settling on Zyklon B, the Nazis had experimented with specially adapted carbon monoxide gas vans to induce mass killing at the Russian front.⁷⁷

No clearly structured chemical casualty management was established for camp inmates after liberation. All camp inmates had baseline clinical presentation consistent with food deprivation, malnutrition, and

close-quartering, and all were physically, mentally, and emotionally exhausted from atrocious working and living conditions. Diseases such as typhus, tuberculosis, and dysentery were evidenced. The US military medical organization faced a multifaceted presentation for which it had no organizational adaptations.

Chemicals in Korea and Vietnam

After World War II the management of chemical casualties shifted back to research and training. The Korean War did not produce any documented chemical casualties. The organization for medically managing chemical casualties during the Vietnam era was similarly untried, though the United States did use chemical defoliants in Vietnam for canopy clearing and crop destruction. It also used tear gas for clearing tunnels and bunkers (Figure 3-18).⁷⁸ "Tunnel rats" were often Chemical Corps personnel assigned to use *o*-chlorobenzylidene malononitrile agent (known as "CS," a riot control agent) when searching for enemy



Fig. 3-18. Tear gas was used extensively by US forces in the Vietnam War, especially in clearing enemy tunnel complexes. However, the US government did not consider tear gas to be a chemical weapon and therefore did not consider its use to be banned by international law. Many others outside of government disagreed, using as evidence the fact that those who used tear gas wore protective masks. The soldiers shown here are wearing the little-known M28 protective mask. This lightweight (and perhaps more comfortable) mask was designed to be worn in situations in which the threat was not from nerve agents, and the heavy-duty protection offered by the standard masks was not necessary.

Photograph: Courtesy of Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

burrowers. Resulting riot control agent casualties did not engender special organizational changes to the existing management schemas. Because defoliants were not used as tactical weapons, casualties exposed to them were not managed outside the realm of usual exposure protocols.

Field Training

For realistic field preparation, the Army conducted training such as Operation Solid Shield 87, which tested how US troops performed on a chemically contaminated battlefield. Over 40,000 personnel from the US Army, Navy, Marine Corps, Air Force, and Coast Guard participated in simulated chemical attacks. Of the many conclusions drawn from the training, the impact on medical personnel trying to help both conventional and chemical casualties caused particular concern:

Use of chemical weapons in an otherwise conventional warfare scenario will result in significant impact on the medical capability to treat and handle casualties. Many medical facilities might be located near chemical target areas and may be subject to contamination.

These facilities include battalion aid stations, hospital and medical companies, casualty receiving and treatment ships, fleet hospitals, and hospital ships. Provision of medical care in a contaminated environment is extremely difficult due to the encapsulation of medical personnel in their individual protective ensembles.

Medical care is best provided in an environment free of toxic agents. This environment might be provided by a collectively protected facility, or be in an uncontaminated area. Medical units ashore and afloat can expect to receive contaminated casualties and must be prepared to provide contaminated casualties with a comprehensive and thorough decontamination. This procedure is similar whether processing patients into a collectively protected facility or processing from a contaminated area to an area free of contamination.^{79(p31)}

One officer summed up this new way of thinking about chemical training as demonstrated by Solid Shield 87:

NBC warfare is not a separate, special form of war, but is instead a battlefield condition just like rain, snow, darkness, electronic warfare, heat, and so on. Units must train to accomplish their wartime missions under all battlefield conditions. Whenever NBC is separated from other training events, we condition our soldiers to regard operations under NBC conditions as a separate form of warfare.^{79(p31)}

To reflect conceptual and equipment changes, the Army's field manuals were rewritten and updated to incorporate chemical warfare readiness into the Army's air-land battle doctrine. The five parts of the new doctrine called for contamination avoidance, individual and collective protection, decontamination, chemical weapons employment, and the deliberate use of smoke.⁸⁰ Military medicine had to incorporate improved overpressure systems in collective protection as part of their management of chemical casualties.

Chemical Use After Vietnam

The post-Vietnam era heralded an age of terrorism. Some states, such as Iraq, used chemical terror to control neighbors and citizens. Cyanide and mustard returned to the battlefield during the Iran-Iraq War, and nerve agents (eg, tabun) also debuted on the chemical battlefield (see Chapter 2). Iranian medical staffs were forced to manage chemical casualties during the conflict, and their atropine dosing protocols are the basis for nerve agent management today. The presence of chemical casualties within a Kurdish population in northern Iraq in 1988 did not lend itself to increased knowledge of chemical casualty management, although over 5,000 people lost their lives in an attack later confirmed by the United Nations to have involved sulfur mustard and nerve agent.⁸¹

In the Persian Gulf War, the Spearhead Division (3rd Armored Division [forward]) was commanded by Major General Paul E Funk, who modified the medical support organization of the cavalry elements by attaching an additional medical platoon.^{82,83} On March 1, 1991, Private First Class David Allen Fisher, a cavalry soldier with the 3rd Armored Division, was medically processed (Exhibit 3-8).⁸⁴ Fisher, who had been investigating one of many munitions bunkers, presented with two 2-cm blisters on his left forearm. After Fisher was initially diagnosed with a spider bite, unit aid station personnel Chief Warrant Officer 2 Ahmed and Chief Warrant Officer 3 Wildhelm began to suspect that chemical weaponry might be involved. The warrant officers evacuated Fisher to C Company of the 45th Support Battalion, where a physician's evaluation was performed. Soon a Fox (Fuchs) vehicle was dispatched and Fox infrared analysis indicated that mustard was present at the site Fisher had been inspecting.⁸⁵

Colonel Michael Dunn filed a medical report indicating Fisher's management by cavalry, division, and forward support battalion personnel. The medical personnel at the cavalry aid station and the physician at the 45th Forward Support Battalion were graduates of the Medical Management of Chemical

EXHIBIT 3-8

A CASE OF ACCIDENTAL EXPOSURE

AETV-TF-CC

10 June 1991

MEMORANDUM FOR RECORD

SUBJECT: Chemical Casualty Occurring During "Bunker Search and Equipment Destruction Mission" Within the 3AD Area of Operation.

1. On 01 Mar 91, PFC David A. Fisher . . . , a 19D cavalry scout assigned to the 4/8th Cav, 3AD was performing a search and destroy mission of Iraqi equipment and bunker complexes. Somewhere among the several complexes he visited he brushed against an unknown surface which deposited a chemical agent upon his flack jacket and his Nomex suit. He was unaware of the contact with the chemical agent.

2. PFC Fisher returned back to his unit still unaware of any contact. He was assigned to morning guard duty at 0100 hrs on 02 Mar. He noticed a redness associated with skin irritation on his upper left arm which felt like a "spider bite". By 0400 the same day, blisters appeared. The blisters were in the area of his polio-immunization site. The blister size was 1/4" x 1/2". Later that morning he reported to sick call to get treatment. He was not treated for a chemical injury at that time.

3. Later that day his signs and symptoms did not go away. His blisters spread to his lower arm. He returned to sick call where he underwent skin decontamination. At this point he was processed as a chemical agent casualty and treated as such.

4. Chemical RECON (FOX) vehicles were dispatched to "sniff" the articles of clothing and to search bunkers in the AO for signs of chemical contamination. The FOX mass spectrometer tapes indicated the presence of an H-series blister agent. On 03 Mar 0940, HD chemical blister agent was reported to be found in a bunker at location QU 050072.

5. Clinical confirmation came from Col Dunn M.D., Commander of the US Army Medical Research Institute of Chemical Defense. Col Dunn stated that PFC Fisher showed a sufficient clinical history and syptomotology to classify him as a classical Mustard agent (blister) casualty. Col Dunn, further stated that if a positive urine test for thiodiglycol, a breakdown products of mustard agent, could be gathered, then the clinical diagnosis was sound. A urine specimen was taken.

6. . . . 3AD Division Surgeon, confirmed that the urine test was positive. PFC Fisher was confirmed to be a chemical "mustard blister agent" casualty. The clothing, flack jacket, and fluid from the blisters were secured from 2d BDE by . . . and 513th MI personnel for further analysis and control.

. . .

Assistant Division Chemical Officer 423

Data source: *Chemical Casualty Occurring During "Bunker Search and Equipment Destruction Mission" Within the 3AD Area of Operation*. US Department of the Army, Third Armored Division; 1991. Memorandum, 10 June 1991. Available at: http://www.gulflink.osd.mil/fisher_ii/fisher_ii_refs/n45en062/970725_sep96_decls26_0001.htm. Accessed April 15, 2008.

and Biological Casualties Course (taught by US Army Medical Research Institute of Chemical Defense) and were confident of their suspicions.

The value of chemical casualty management lies in staff coordination and communication of medical information. Russia's 2002 use of nonlethal gas against Chechnyan terrorists at a Moscow theater (see Chapter 2)

provides an example of unsuccessful chemical casualty management. Had Russian special operations personnel indicated to first responders and receivers the nature of the chemical weapon used, the judicious use of nalaxone could have been easily planned. Instead, healthcare providers thought they were facing a new nerve agent and were unable to respond appropriately.

PROJECTIONS FOR THE FUTURE OF CHEMICAL CASUALTY MANAGEMENT

The historical key to the success of managing chemical casualties has unfortunately been hands-on experience. Today's military medical community has no residency or specialty training in disaster or terror medicine other than that offered at the US Army Medical Research Institute of Chemical Defense. Lieutenant Colonel Edward Vedder's "course for medical officers" has evolved into comprehensive training for all facets of the US government and allied countries as well. Modern audiovisual technologies now bring training to the battlefield. When communication elements support it, an organizational interface with medical and chemical experts in personnel, intelligence, operations, research, and logistics can provide "reach-back"

capabilities for combat decision-makers and their staffs (Figure 3-19). The potential for a trained and confident chemical casualty manager exists if command is willing to engage.

As demand for specialty training increases, the medical community must modify its organization to encompass chemical casualty managers. Educational communities must consider providing residency in specialties including disaster or terror medicine and subspecialties that address the spectrum of chemical casualty management. As long as soldiers are unprepared to manage chemical casualties, sources with the capability to use chemical weapons will engage those capabilities to their best strategic and tactical advantage.

SUMMARY

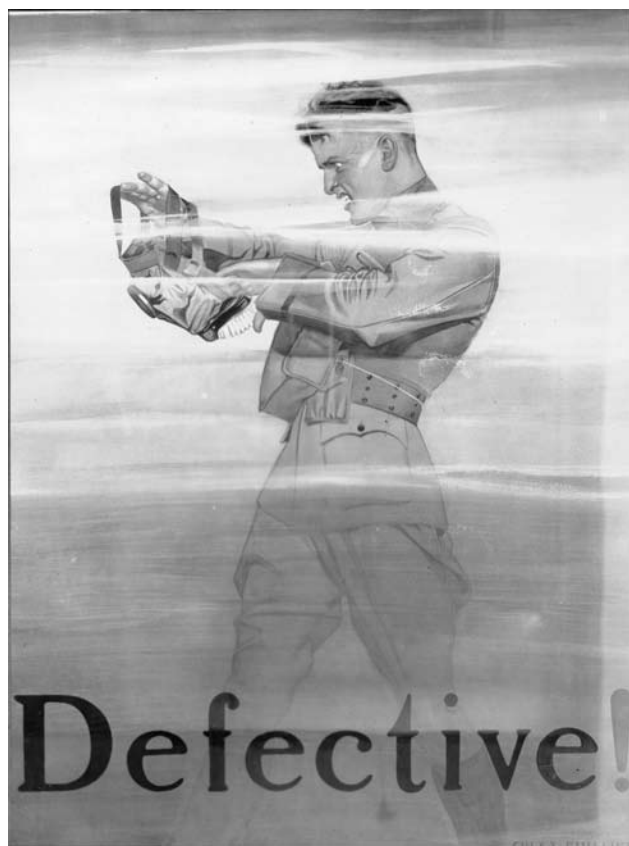


Fig. 3-19. This poster from World War I was designed to encourage enthusiasm for quality assurance among women who manufactured protective masks. Reproduced from: Pictorial History, Gas Defense Division, Chemical Warfare Service. Vol 5. Edgewood Historical Files. Located at: Chemical and Biological Defense Command Historical Research and Response Team, Aberdeen Proving Ground, Md.

Combatants respond to a current war in the manner in which they conducted the previous one. In terms of employing medical assets on a chemical battlefield, World War I saw units on both sides of the battlefield performing reactively rather than proactively. After all the lessons learned in World War I, the chemical casualties of the Bari disaster found themselves medically managed by physicians who were still unable to meet the minimum standard of care for chemical casualties. After World War II, the fate of the chemical casualty fell into the hands of medical personnel untrained in the appropriate medical management. This disconnect among experts in chemical warfare, military medicine, and military personnel must be addressed so that casualties on the chemical battlefield have the service support system that yields the greatest chance for success. Today, when terrorists are sufficiently organized to bring chemicals to the home front, base hospitals, military medical centers, and other medical treatment facilities must be competently prepared for chemical casualties.

Lieutenant Colonel Vedder studied with medical historian Richard Shryock, who suggested that all sciences must pass through stages of development. Vedder said of Shryock:

In his landmark work, *The Development of Modern Medicine*, Shryock postulates that all sciences, including medicine, must pass through four stages of development. The first is a period of minimal observation and maximal theoretical synthesis. The second is an early attempt at objectivity and measurement. The third stage sees a partial lapse of quantitative procedures due to unforeseen difficulties, while the fourth is a revival of such procedures with "a final victory for modern technology."

For North American medicine, the leap from the first stage to the second was the most difficult, because it required a change in professional modes of thinking: the medical educator (if not the average practitioner) had to come to understand and accept the importance of the scientific method for the advancement of medical knowledge. Attainment of the fourth stage, medicine's "final victory," required as well a change in American social values: the average citizen had to perceive the products of scientific investigation as important—

indeed necessary.⁸⁶

There is still much to learn about medically managing chemical casualties. Past lessons must be combined with current research and future predictions to best prepare military medical personnel for a chemical attack. The United States has not seen chemical warfare in any sizable scale since World War I, but its military medical personnel must continually be ready to respond in the event of an attack.

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